V2406/2422/2426
Linux User's Manual

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V2406/2422/2426
Linux User's Manual

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1

Introduction

Thank you for purchasing the Moxa V2406/2422/2426 of x86 ready-to-run embedded computers. This manual introduces the software configuration and management of the V2406/2422/2426-LX, which runs the Linux operating system. For hardware installation, connector interfaces, setup, and upgrading the BIOS, please refer to the "V2406/2422/2426 Hardware User's Manual."

Linux is an open, scalable operating system that allows you to build a wide range of innovative, small footprint devices. Software written for desktop PCs can be easily ported to the embedded computer with a GNU cross compiler and a minimum of source code modifications. A typical Linux-based device is designed for a specific use, and is often not connected to other computers, or a number of such devices connect to a centralized, front-end host. Examples include enterprise tools such as industrial controllers, communications hubs, point-of-sale terminals, and display devices, which include HMIs, advertisement appliances, and interactive panels.

This chapter covers the following topics:

- **Overview**
- **Software Specifications**
- **Software Components**

Overview

V2101 embedded computers are based on the Intel Atom N270 x86 processor and feature two serial ports, dual 10/100 or 10/100/1000 Mbps LAN ports, three or six USB 2.0 hosts, and an SD socket. The V2406/2422/2426 series offers both VGA and DVI-I outputs, making it exceptionally well suited for industrial applications such as SCADA and factory automation.

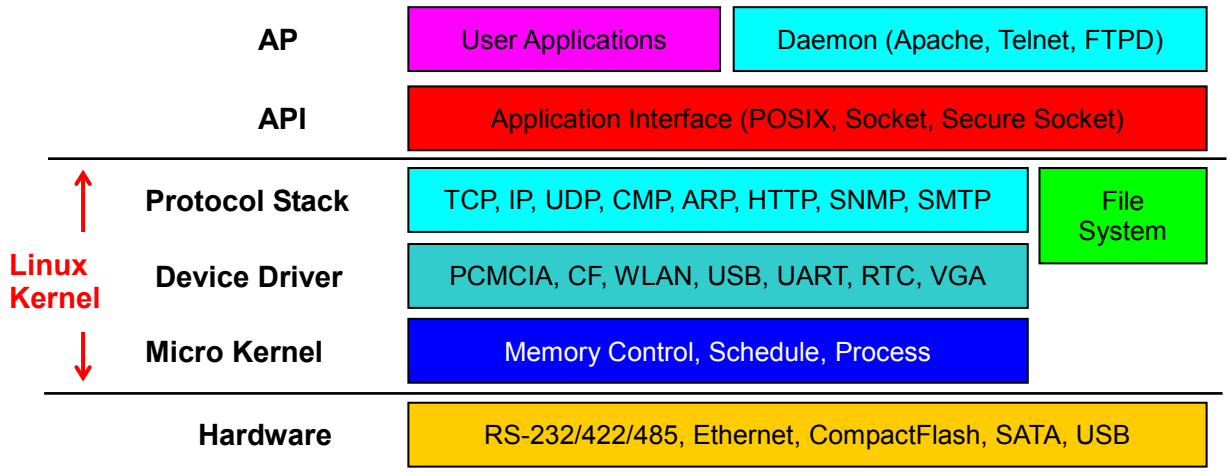
The V2406/2422/2426's four serial ports make it ideal for connecting a wide range of serial devices, and the dual 10/100 or 10/100/1000 Mbps Ethernet ports offer a reliable solution for network redundancy, which taken together promise continuous data communication and management operations. For added convenience, the V2406/2426 have 6 DIs and 2 DOs, and V2422 comes with 4 DIs and 4 DOs for connecting digital input/output devices. In addition, the SD and USB ports provide V2406/2422/2426 computers with data buffering and storage expansion, which provide the necessary reliability for industrial applications.

Pre-installed with Linux, the V2406/2422/2426 Series provides programmers with a friendly environment for developing sophisticated, bug-free application software at a lower cost.

All V2406/2422/2426 models support a wide operating temperature range of -40 to 70°C for use in harsh industrial environments.

Software Specifications

The Linux operating system pre-installed on the V2406/2422/2426 embedded computer is the **Debian Lenny 5.02** distribution. The Debian project is a worldwide group of volunteers who endeavor to produce an operating system distribution that composed entirely of free software. The Debian GNU/Linux follows the standard Linux architecture, making it easy to use programs that meet the POSIX standard. Program porting can be done with the GNU Tool Chain provided by Moxa. In addition to Standard POSIX APIs, device drivers for Moxa UART and other special peripherals are also included. An example software architecture is shown below:



ATTENTION

Refer to http://www.debian.org/ and http://www.gnu.org/ for information and documentation of the Debian GNU/Linux and free software concept.

ATTENTION

The above software architecture is only an example. Different models or different build revisions of the Linux operating system may include components not shown in the above graphic.

Software Components

The V2406/2422/2426-LX pre-installed Debian Lenny 5.02 Linux distribution. For the software components, see **Appendix A**.

2

Software Configuration

In this chapter, we explain how to operate a V2406/2422/2426-LX computer directly or your desktop. There are three ways to connect to the V2406/2422/2426-LX computer: through VGA monitor, by using Telnet over the network, or by using an SSH console from a Windows or Linux machine. This chapter describes basic Linux operating system configurations. The advanced network management and configuration will be described in the next chapter "Managing Communications."

This chapter covers the following topics:

- **The Read-only File System**
- **Starting from a VGA Console**
- **Display on Single or Multiple Outputs**
- **Connecting from a Telnet Console**
- **Connecting from an SSH Console**
  - **Windows Users**
  - **Linux Users**
- **Adjusting the System Time**
  - **Setting the Time Manually**
  - **NTP Client**
  - **Updating the Time Automatically**
- **Enabling and Disabling Daemons**
- **Setting the Run-Level**
- **Cron—Daemon for Executing Scheduled Commands**
- **Inserting a USB Storage Device into the Computer**
- **Inserting a Compact Flash card**
- **Checking the Linux Version**
- **APT—Installing and Removing Packages**
- **Device SuspendWake on LAN**

The Read-only File System

The root file system(/) in Moxa's embedded system is mounted as read-only for prevent unexpected crash. If you want to make it writable temporarily, please following the steps:

1. make the root file system (/) writable

```
Moxa:~# mount -o remount,rw /
```

2. perform your operations, such as apt-get and disk-access
3. umount it as read-only

```
Moxa:~# umount /
```

Starting from a VGA Console

Connect the display monitor to the V2406/2422/2426-LX VGA connector, and then power it up by connecting it to the power adaptor. It takes about 30 to 60 seconds for the system to boot up. Once the system is ready, a login screen will appear on your monitor.

To log in, type the login name and password as requested. The default values are both **root**.

Login: root

Password: root

```
Moxa login: root
Password:
Last login: Mon Jan 22 19:02:16 2007 from 192.168.3.120

    ####       ####    ######    ####### ######      ##
     ###      ####   ###    ###    ####   ####      ###
      ###     ###   ###     ###    ###    ##       ###
      ###    ####   ##       ##    ###   #        ####
      ####    # ##  ###      ###    ### ##       ## ##
     ## ##    # ##  ###      ##     ####        #  ##
     ## ###  ## ##  ##       ##     ####        #  ###
     ##  ##  #  ##  ##        ##      ###       #######
     ##  ##  #  ##  ###      ###     #####      #    ##
     ##   ###   ##  ###      ###    ##  ###     #    ###
     ##   ###   ##   ##      ##     ##    ###   ##     ##
     ##   ###   ##    ##     ##     #     ###   #      ##
   ######  #  ######   ########   ####### ###########  ######

For further information check:
http://www.moxa.com/
Mount user file system.

Moxa:~#
```

Display on Single or Multiple Outputs

This section introduces how to configure xorg.conf file for displaying on two cases: (1) single output and (2) both VGA and DVI output.

Please follow below steps:

1. Open xorg.conf file and modify the device, monitor, and screen sections.
   a. To only display on VGA port, use the following setting:

```
...
        Section "Device"
                Identifier      "Intel Corporation Mobile 945GM/GMS,
        943/940GML Express Integrated Graphics Controller"
                Driver          "intel"
                Option          "monitor-VGA"   "VGA"
                Option          "monitor-TMDS-1" "TMDS-1"
                Option          "monitor-LVDS" "LVDS"
        EndSection

        Section "Monitor"
                Identifier      "VGA"
        EndSection

        Section "Monitor"
                Identifier      "TMDS-1"
                Option  "Ignore" "true"
        EndSection

        Section "Monitor"
                Identifier      "LVDS"
                Option  "Ignore" "true"

        EndSection

        Section "Screen"
                Identifier      "Screen0"
                Device          "Intel Corporation Mobile 945GM/GMS,
        943/940GML Express Integrated Graphics Controller"
                Monitor         "VGA"
        EndSection
        …
```

Here we setup the option to ignore the TMDS-1(DVI) port and the LVDS port.

b. To only display on DVI port， use the following setting:

```
...
        Section "Device"
                Identifier      "Intel Corporation Mobile 945GM/GMS,
        943/940GML Express Integrated Graphics Controller"
                Driver          "intel"
                Option          "monitor-VGA"   "VGA"
                Option          "monitor-TMDS-1" "TMDS-1"
                Option          "monitor-LVDS" "LVDS"
        EndSection

        Section "Monitor"
                Identifier      "VGA"
                Option    "Ignore" "true"
        EndSection

        Section "Monitor"
                Identifier      "TMDS-1"
        EndSection

        Section "Monitor"
                Identifier      "LVDS"
                Option    "Ignore" "true"

        EndSection

        Section "Screen"
                Identifier      "Screen0"
                Device          "Intel Corporation Mobile 945GM/GMS,
        943/940GML Express Integrated Graphics Controller"
                Monitor         "TMDS-1"
        EndSection
        …
```

It ignores the VGA port and LVDS port.

c. To display on both VGA and DVI port, you only need to ignore LVDS monitor section.

```
…
        Section "Device"
                Identifier      "Intel Corporation Mobile 945GM/GMS,
        943/940GML Express Integrated Graphics Controller"
                Driver          "intel"
                Option          "monitor-VGA"   "VGA"
                Option          "monitor-TMDS-1" "TMDS-1"
                Option          "monitor-LVDS" "LVDS"
        EndSection

        Section "Monitor"
                Identifier      "VGA"
        EndSection

        Section "Monitor"
                Identifier      "TMDS-1"
        EndSection

        Section "Monitor"
                Identifier      "LVDS"
                Option    "Ignore" "true"

        EndSection

        Section "Screen"
                Identifier      "Screen0"
                Device          "Intel Corporation Mobile 945GM/GMS,
        943/940GML Express Integrated Graphics Controller"
                Monitor         "VGA"
        EndSection
...
```

2. Now you can issue following command to test your setting

```
MOXA:~# /etc/init.d/gdm start
```

3. For login in at desktop environment, do following command

```
MOXA:~# mv /etc/rc2.d/N30gdm /etc/rc2.d/S30gdm
```

4. Then reboot Moxa's embedded computer to start at desktop environment

Startup with Desktop Environment

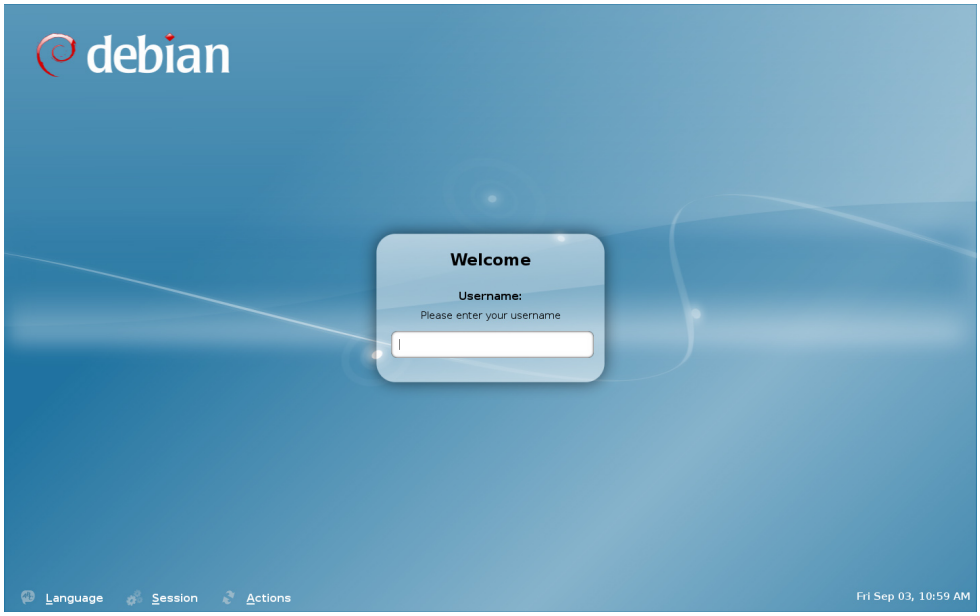
This section introduces the display configuration for v242x series. V2420 provides both VGA and DVI output. Connect them to V2420 and issue "/etc/init.d/gdm start" to start Xwindows from text console. Besides, you can start gnome desktop environment in text console:

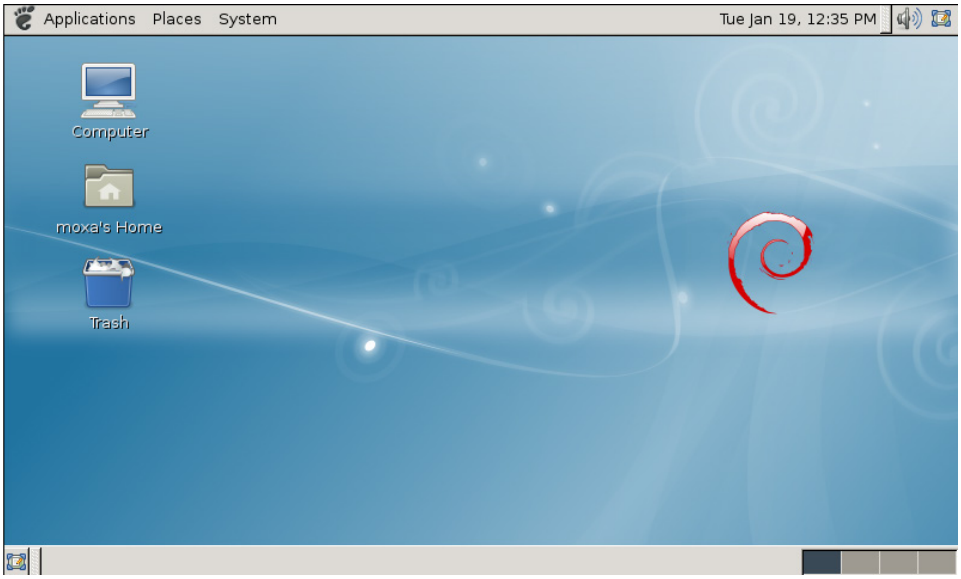
```
MOXA:~# /etc/init.d/gdm start
```

Or setup gnome-display-manager as startup daemon:

```
MOXA:~# mv /etc/rc2.d/N30gdm /etc/rc2.d/S30gdm
```

Then, you can see login window as below:





Connecting from a Telnet Console

The V2406/2422/2426-LX computer comes with two Ethernet ports named LAN1 and LAN2. The default IP addresses and netmasks of the network interfaces are as follows:

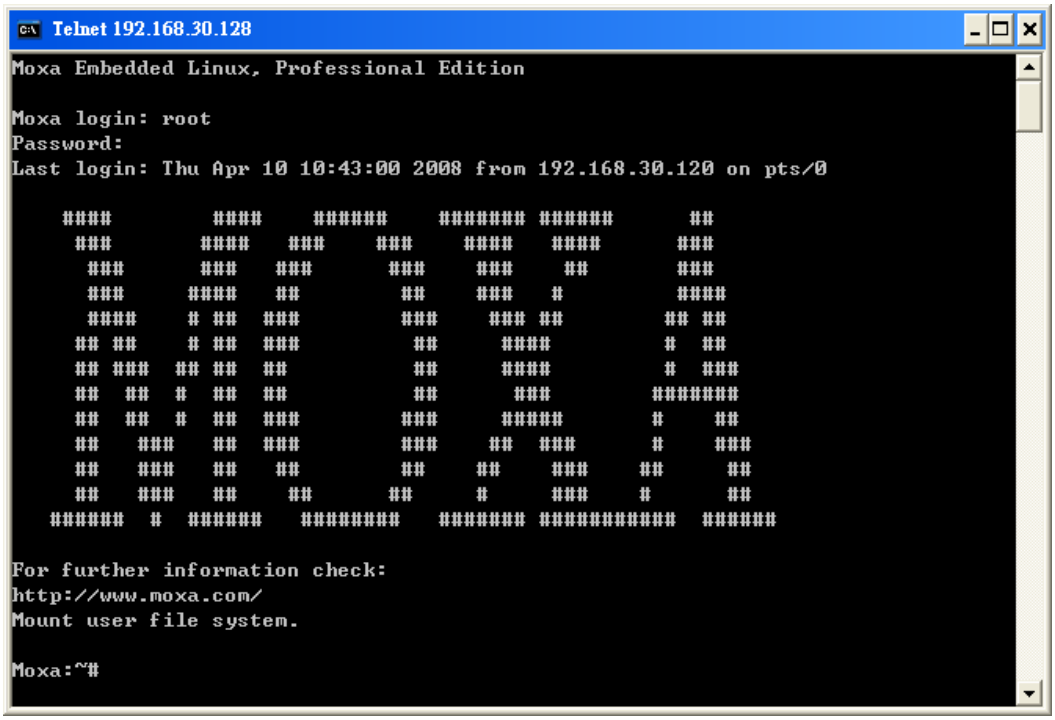
	Default IP Address	Netmask
LAN 1	192.168.3.127	255.255.255.0
LAN 2	192.168.4.127	255.255.255.0

Before using the Telnet client, you should change the IP address of your development workstation so that the network ports are on the same subnet as the IP address for the LAN port that you connect to. For example, if you connect to LAN 1, you could set your PC's IP address to 192.168.3.126, and the netmask to 255.255.255.0. If you connect to LAN 2, you can set your PC's IP address to 192.168.4.126, and the netmask to 255.255.255.0.

Use a cross-over Ethernet cable to connect your development workstation directly to the target computer, or use a straight-through Ethernet cable to connect the computer to a LAN hub or switch. Next, use a Telnet client on your development workstation to connect to the target computer. After a connection has been established, type the login name and password as requested to log on to the computer. The default values are both **root**.

Login: root

Password: root

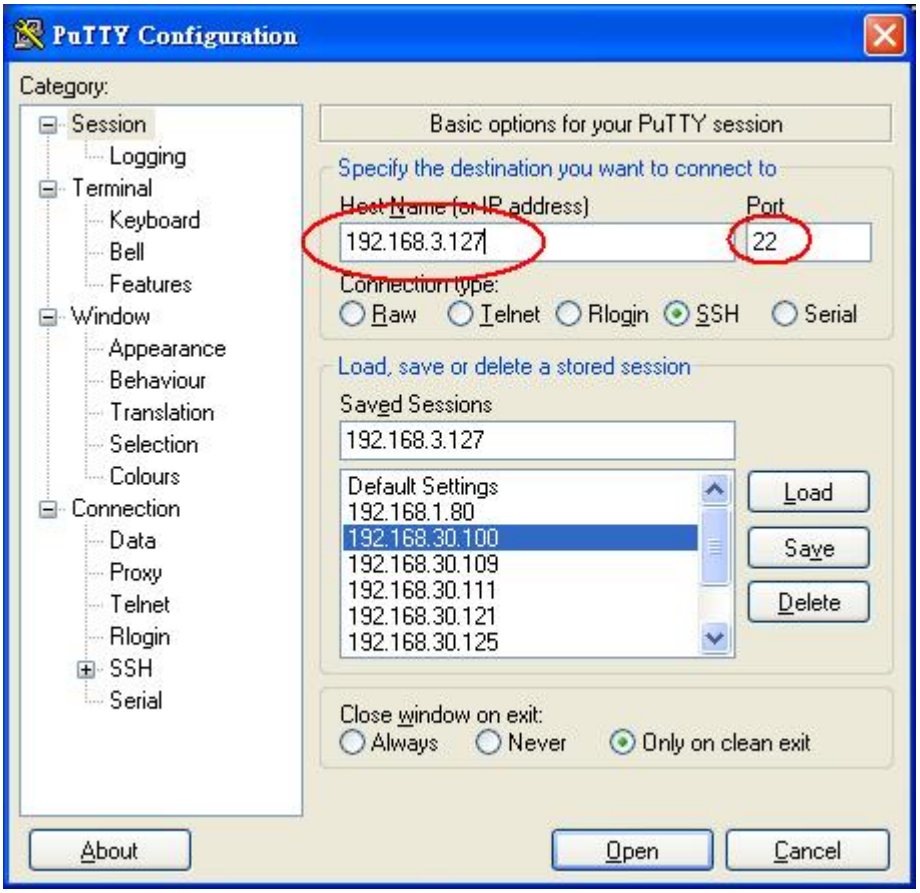


Connecting from an SSH Console

The V2406/2422/2426-LX computer supports an SSH Console to offer users with better security over the network compared to Telnet.

Windows Users

Click on the link http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html to download **PuTTY** (free software) to set up an SSH console for the V2406/2422/2426-LX in a Windows environment. The following screen shows an example of the configuration that is required.



Linux Users

From a Linux machine, use the **ssh** command to access the V2101-LX's console utility via SSH.

#ssh 192.168.3.127

Select **yes** to open the connection.

```
[root@bee_notebook root]# ssh 192.168.3.127
The authenticity of host '192.168.3.127 (192.168.3.127)'
can't be established.
RSA key fingerprint is
8b:ee:ff:84:41:25:fc:cd:2a:f2:92:8f:cb:1f:6b:2f.
Are you sure you want to continue connection (yes/no)? yes_
```

Adjusting the System Time

The V2406/2422/2426-LX has two time settings. One is the system time, and the other is provided by an RTC (Real Time Clock) built into the V2406/2422/2426-LX's hardware.

Setting the Time Manually

Use the **date** command to query the current system time or set a new system time. Use **hwclock** to query the current RTC time or set a new RTC time.

Use the following command to set the system time.

 # date MMDDhhmmYYYY

MM: Month
DD: Date
hhmm: Hour and Minute
YYYY: Year

Use the following command to write the current system time to the RTC.

 # hwclock –w

```
MOXA:~# date
         Wed Dec 16 03:34:46 CST 2009

MOXA:~# hwclock
Wed 16 Dec 2009 03:35:16 AM CST  -0.017600 seconds
MOXA:~# date 121616352009
Wed Dec 16 16:35:00 CST 2009
MOXA:~# hwclock –w
MOXA:~# date ; hwclock
Wed Dec 16 16:36:12 CST 2009
Wed 16 Dec 2009 03:38:13 AM CST -0.016751 seconds
MOXA:~#
```

NTP Client

The V2406/2422/2426-LX has a built-in NTP (Network Time Protocol) client that is used to initialize a time request to a remote NTP server. Use **ntpdate** to update the system time.

#ntpdate time.stdtime.gov.tw

#hwclock –w

Visit http://www.ntp.org for more information about NTP and NTP server addresses.

```
MOXA:~# date ; hwclock
Wed Dec 16 16:36:12 CST 2009
Wed 16 Dec 2009 03:38:13 AM CST -0.016751 seconds
MOXA:~#
MOXA:~# ntpdate time.stdtime.gov.tw
 16 Dec 03:49:48 ntpdate[2510]: step time server 220.130.158.52
offset 155905087.9
84256 sec
MOXA:~#
MOXA:~# hwclock -w
MOXA:~# date ; hwclock
Wed Dec 16 03:51:07 CST 2009
Wed 16 Dec 2009 03:51:07 AM CST    -0.016771 seconds
MOXA:~#
```

ATTENTION

Before using the NTP client utility, check your IP address and network settings (gateway and DNS) to make sure an Internet connection is available.

Updating the Time Automatically

This section describes how to use a shell script to update the time automatically.

Example shell script for updating the system time periodically

#!/bin/sh
ntpdate time.stdtime.gov.tw
 # You can use the time server's ip address or domain
 # name directly. If you use domain name, you must
 # enable the domain client on the system by updating
 # /etc/resolv.conf file.
hwclock –w
sleep 100
 # Updates every 100 seconds. The min. time is 100 seconds.
 # Change 100 to a larger number to update RTC less often.

Save the shell script using any file name. For example, **fixtime**.

How to run the shell script automatically when the kernel boots up

Because the root file system is mounted in Read-only mode, we need to re-mount it using writable permission.

 # mount -o remount,rw /dev/hda1 /

Copy the example shell script **fixtime** to directory **/etc/init.d**, and then use **chmod 755 fixtime** to change the shell script mode.

 # chmod 755 fixtime

Next, use **vi** editor to edit the file **/etc/inittab**.

 # vi /etc/inittab

Add the following line to the bottom of the file:

ntp : 2345 : respawn : /etc/init.d/fixtime

After you finish writing or modifying the code, remember to execute "umount /" to change the root directory back to Read-only mode.

 # umount /

Use the command **#init q** to re-initialize the kernel.

 # init q

Enabling and Disabling Daemons

The following daemons are enabled when the V2406/2422/2426-LX boots up for the first time.

- **snmpd** SNMP Agent Daemon
- **telnetd** Telnet Server/Client Daemon
- **inetd** Internet Daemons
- **ftpd** FTP Server/Client Daemon
- **sshd** Secure Shell Server Daemon
- **httpd** Apache WWW Server Daemon

Type the command **ps –ef** to list all processes currently running.

```
MOXA:~# ps -ef
    PID  Uid        VmSize Stat  Command
      1  root          1296 S    init
      2  root               S    [keventd]
      3  root               S    [ksoftirqd_CPU0]
      4  root               S    [kswapd]
      5  root               S    [bdflush]
      6  root               S    [kupdated]
      7  root               S    [mtdblockd]
      8  root               S    [khubd]
     10  root               S    [jffs2_gcd_mtd3]
     32  root               D    [ixp425_csr]
     38  root          1256 S    stdef
     47  root          1368 S    /usr/sbin/inetd
     53  root          4464 S    /usr/sbin/httpd
     63  nobody        4480 S    /usr/sbin/httpd
     64  nobody        4480 S    /usr/sbin/httpd
     65  nobody        4480 S    /usr/sbin/httpd
     66  nobody        4480 S    /usr/sbin/httpd
     67  nobody        4480 S    /usr/sbin/httpd
     92  bin           1460 S    /sbin/portmap
    105  root          1556 S    /usr/sbin/rpc.statd
    109  root          4044 S    /usr/sbin/snmpd -s -l /dev/null
    111  root          2832 S    /usr/sbin/snmptrapd -s
    140  root          1364 S    /sbin/cardmgr
    144  root          1756 S    /usr/sbin/rpc.nfsd
    146  root          1780 S    /usr/sbin/rpc.mountd
    153  root          2960 S    /usr/sbin/sshd
    161  root          1272 S    /bin/reportip
    162  root          3464 S    /bin/massupfirm
    163  root          1532 S    /sbin/getty 115200 ttyS0
    164  root          1532 S    /sbin/getty 115200 ttyS1
    166  root          3464 S    /bin/massupfirm
    168  root          3464 S    /bin/massupfirm
    171  root          3652 S    /usr/sbin/sshd
    172  root          2200 S    -bash
    174  root          1592 S    ps -ef
MOXA:~#
```

To run a private daemon, you can edit the file **rc.local** as follows:

1. Because the root file system is mounted in Read-only mode, you need to re-mount it with write permission.

```
MOXA:~# mount -o remount,rw /dev/hda1 /
```

2. Type **cd /etc/** to change directories.

```
MOXA:~# cd /etc/
```

3. Type **vi rc.local** to edit the configuration file with vi editor.

```
MOXA:/etc/# vi rc.local
```

4. Next, add the application daemon that you want to run. We use the example program **tcps2-release** which you can find in the CD to illustrate, and configure it to run in the background.

```
# !/bin/sh
# Add you want to run daemon
/root/tcps2-release &~
```

5. After you finish writing or modifying the code, remember to execute "umount /" to change the root directory back to Read-only mode.

```
MOXA:~# umount /
```

6. You should be able to find the enabled daemon after you reboot the system.

```
MOXA:~# ps -ef
    PID  Uid        VmSize Stat  Command
      1  root          1296 S    init
      2  root               S    [keventd]
      3  root               S    [ksoftirqd_CPU0]
      4  root               S    [kswapd]
      5  root               S    [bdflush]
      6  root               S    [kupdated]
      7  root               S    [mtdblockd]
      8  root               S    [khubd]
     10  root               S    [jffs2_gcd_mtd3]
     32  root               D    [ixp425_csr]
     38  root          1256 S    stdef
     47  root          1368 S    /usr/sbin/inetd
     53  root          4464 S    /usr/sbin/httpd
     63  nobody        4480 S    /usr/sbin/httpd
     64  nobody        4480 S    /usr/sbin/httpd
     65  nobody        4480 S    /usr/sbin/httpd
     66  nobody        4480 S    /usr/sbin/httpd
     67  nobody        4480 S    /usr/sbin/httpd
     92  bin           1460 S    /sbin/portmap
     97  root          1264 S    /root/tcps2-release
    105  root          1556 S    /usr/sbin/rpc.statd
    109  root          4044 S    /usr/sbin/snmpd -s -l
    /dev/null
    111  root          2832 S    /usr/sbin/snmptrapd -s
    140  root          1364 S    /sbin/cardmgr
    144  root          1756 S    /usr/sbin/rpc.nfsd
    146  root          1780 S    /usr/sbin/rpc.mountd
    153  root          2960 S    /usr/sbin/sshd
    161  root          1272 S    /bin/reportip
    162  root          3464 S    /bin/massupfirm
    163  root          1532 S    /sbin/getty 115200 ttyS0
    164  root          1532 S    /sbin/getty 115200 ttyS1
    166  root          3464 S    /bin/massupfirm
    168  root          3464 S    /bin/massupfirm
    171  root          3652 S    /usr/sbin/sshd
    172  root          2200 S    -bash
    174  root          1592 S    ps -ef
MOXA:~#
```

Setting the Run-Level

To set the Linux run-level and execution priority of a program, use the following command (because the root file system is mounted in Read-only mode, we need to re-mount it with write permission).

```
MOXA:~# mount -o remount,rw /dev/hda1 /
```

Edit a shell script to execute **/root/tcps2-release** and save to **tcps2** as an example.

#cd /etc/rc2.d

#ln –s /etc/root/tcps2 S60tcps2

or

#ln –s /etc/root/tcps2 k30tcps2

```
MOXA:~# cd /etc/rc2.d
MOXA:/etc/rc2.d#
MOXA:/etc/rc2.d# ls
S19nfs-common       S25nfs-user-server  S99showreadyled
S20snmpd            S55ssh
S24pcmcia           S99rmnologin
MOXA:/etc/rc2.d#
MOXA:/etc/rc2.d# ln -s /root/tcps2-release S60tcps2
MOXA:/etc/rc2.d# ls
S19nfs-common       S25nfs-user-server  S99rmnologin
S20snmpd            S55ssh              S99showreadyled
S24pcmcia           S60tcps2
MOXA:/etc/rc2.d#
```

The command **SxxRUNFILE** has the following meaning:

S: **Start the run file while Linux boots up.**
xx: **A number between 00-99. The smaller number has a higher priority.**
RUNFILE: **The script file name**

The command **KxxRUNFILE** has the following meaning:

K: **Start the run file while Linux shuts down or halts.**
xx: **A number between 00-99. The smaller number has a higher priority.**
RUNFILE: **The script file name**

To remove the daemon, remove the run file from /etc/rc2.d by using the following command:

```
MOXA:~# rm -f /etc/rc2.d/S60tcps2
```

After you finish writing or modifying the code, remember to execute "umount /" to change the root directory back to Read-only mode.

```
MOXA:~# umount /
```

Cron—Daemon for Executing Scheduled Commands

The Cron daemon will search **/etc/crontab** for crontab files.

Cron wakes up every minute and checks each command to see if it should be run in that minute. When executing commands, output is mailed to the owner of the **crontab** (or to the user named in the MAILTO environment variable in the **crontab**, if such a user exists).

Modify the file **/etc/crontab** to set up your scheduled applications. **Crontab** files have the following format:

mm	**h**	**dom**	**mon**	**dow**	**user**	**command**
minute	hour	date	month	week	user	command
0-59	0-23	1-31	1-12	0-6 (0 is Sunday)		

For example, if you want to launch a program at 8:00 every day

```
#minute hour  date  month  week  user   command
*        8    *     *      *    root   /path/to/your/program
```

The following example demonstrates how to use **Cron** to update the system time and RTC time every day at 8:00.

1. Write a shell script named fixtime.sh and save it to **/home/**.

   #!/bin/sh
   ntpdate time.stdtime.gov.tw
   hwclock –w
   exit 0

2. Change mode of **fixtime.sh**

   # chmod 755 fixtime.sh

3. Modify /etc/crontab file to run fixtime.sh at 8:00 every day.

   Add the following line to the end of crontab:

   *** 8 * * * root /home/fixtime.sh**

Inserting a USB Storage Device into the Computer

Since mounting USB storage devices manually can be difficult, a Debian package named **usbmount** to mount the USB drivers automatically. **usbmount** relies on **udev** to mount USB storage devices automatically at certain mount points. The USB storage devices will be mounted on **/media/usb0, /media/usb1**, etc.

```
MOXA:~# mount
/dev/hda1 on / type ext2 (rw,errors=remount-ro)
tmpfs on /lib/init/rw type tmpfs (rw,nosuid,mode=0755)
proc on /proc type proc (rw,noexec,nosuid,nodev)
sysfs on /sys type sysfs (rw,noexec,nosuid,nodev)
procbususb on /proc/bus/usb type usbfs (rw)
udev on /dev type tmpfs (rw,mode=0755)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev)
devpts on /dev/pts type devpts
(rw,noexec,nosuid,gid=5,mode=620)
/dev/hdb2 on /home type ext2 (rw)
nfsd on /proc/fs/nfsd type nfsd (rw)
rpc_pipefs on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
/dev/sda1 on /media/usb0 type vfat
(rw,noexec,nodev,sync,noatime,gid=25,dmask=0007,fmask=0117)
/dev/sdb1 on /media/usb1 type vfat
(rw,noexec,nodev,sync,noatime,gid=25,dmask=0007,fmask=0117)
MOXA:~#
```

Note that usbmount is a light-weight solution on text mode and does not fully support gnome desktop environment. For better supportability, you can install gnome-volume-manager instead of usbmount:

```
 MOXA:~# mount -o,remount rw /
 MOXA:~# apt-get remove usbmount
# apt-get install gnome-volume-manager
 MOXA:~# umount /
```

ATTENTION

Remember to type the command **# sync** before you disconnect the USB storage device. If you do not issue the command, you may lose data.

ATTENTION

Remember to exit the **/media/usb0 or /media/usb1** directory when you disconnect the USB storage device. If you stay in **/media/usb0** or **/media/usb1**, the automatic un-mount process will fail. If that happens, type **# umount /media/usb0** to un-mount the USB device manually.

Inserting a Compact Flash card

Moxa's v242x series support the CF card for extensive storage. Because the CF slot does not support hot-plug function, please shutdown the device and insert the CF card into the slot.

After rebooting, the CF card will auto mount at /media/cfn(here n is the number of partition). This is because a udev rule to support this feature in /etc/udev/rules.d/96-moxa.rules:

```
…
# CF automount for v242x
KERNEL=="sd*[1-9]" KERNELS=="1:0:1:0", RUN+="/bin/mount /dev/%k /media/cf%n"
...
```

ATTENTION

If you do not want to mount CF card automatically, just comment the rule in /etc/udev/rules.d/96-moxa.rules.

Checking the Linux Version

The program **uname**, which stands for "Unix Name" and is part of the Unix operating system, prints the name, version, and other details about the operating system running on the computer. Use the **-a** option to generate a response similar to the one shown below:

```
MOXA:~# uname -a
Linux Moxa 2.6.30-bpo.2-686 #1 SMP Fri Dec 11 18:12:58 UTC
2009 i686 GNU/Linux
MOXA:~#
```

APT—Installing and Removing Packages

APT is the Debian tool used to install and remove packages. Before installing a package, you need to configure the apt source file, **/etc/apt/sources.list**, which is located in the read-only partition.

1. Mount the root file system with write permission.

```
MOXA:~# mount -o remount,rw
```

2. Next, configure the **/etc/apt/sources.list** using **vi** editor.

```
MOXA:~# vi /etc/apt/sources.list

#
# deb cdrom:[Debian GNU/Linux 5.0.2a _Lenny_ - Official i386
NETINST Binary-1 20090817-16:43]/ lenny main

#deb cdrom:[Debian GNU/Linux 5.0.2a _Lenny_ - Official i386
NETINST Binary-1 20090817-16:43]/ lenny main

deb http://ftp.us.debian.org/debian/ lenny main
deb-src http://ftp.us.debian.org/debian/ lenny main

deb http://security.debian.org/ lenny/updates main contrib
deb-src http://security.debian.org/ lenny/updates main contrib

deb http://volatile.debian.org/debian-volatile lenny/volatile
main
deb-src http://volatile.debian.org/debian-volatile
lenny/volatile main
```

3. Update the source list after you configure it.

```
MOXA:~# apt-get update
MOXA:~#
```

4. Once you indicate which package you want to install (**openswan**, for example), type:

```
MOXA:~# apt-get install openswan
MOXA:~#
```

5. Use one of the following commands to remove a package:
   (a) For a simple package removal:

```
MOXA:~# apt-get remove openswan
MOXA:~#
```

   (b) For a complete package removal:

```
MOXA:~# apt-get remove openswan --purge
MOXA:~#
```

6. If the installation is complete, remember to umount the root directory back to read-only mode.

```
MOXA:~# umount /
MOXA:~#
```

ATTENTION

The APT cache space **/var/cache/apt** is located in **tmpfs**. If you need to install a huge package, link **/var/cache/apt** to USB mass storage or mount it to an NFS space to generate more free space. Use **df –h** to check how much free space is available on **tmpfs**.

```
Moxa:~# df -h
Filesystem          Size  Used Avail Use% Mounted on
rootfs              1.5G 1001M  440M  70% /
udev                 10M  748K  9.3M   8% /dev
/dev/sda1           1.5G 1001M  440M  70% /
tmpfs               501M     0  501M   0% /lib/init/rw
tmpfs               501M     0  501M   0% /dev/shm
none                501M   19M  482M   4% /tmp
/dev/sda2           270M  130M  126M  51% /home
Moxa:~#
```

ATTENTION

You can free up the cache space with the command **# apt-get clean**

```
MOXA:~# apt-get clean
MOXA:~#
```

Device Suspend

The V2406/2422/2426-LX supports ACPI S3 (suspend to ram), You should enable option S3 in the BIOS, and

use "pm-suspend --qurik-s3-bios" command.

After suspend, you can press the power button to wake up the computer.

```
MOXA:~# pm-suspend --quirk-s3-bios
```

If you login in as administrator (root) in X windows, you can use **System -> Shutdown> Suspend** to suspend your device. Note: This does not work for non-root users,.

Some components on Moxa's embedded computer may need to be reset after resuming. You can write a simple script in the directory **/usr/lib/pm-utils/sleep.d/** to complete this procedure. For example, you could create a **script 99serial** for your application.

```
#!/bin/sh

case "$1" in
      hibernate|suspend)
            echo "close AP and tty ports which are opened"
            echo "operations before serial ports suspend"
            ;;
      thaw|resume)
            echo "restart AP"
            echo "operations after serial ports resume"
            ;;
      *) exit $NA
```

Note: If you want to see how to execute the script, start rsyslogd with command "/etc/init.d/rsyslogd start" and view the file /var/log/pm-suspend.log.

Wake on LAN

The V2406/2422/2426-LX supports wake on LAN, a feature to wake up a device for suspend (S3) and shutdown (S5).

To check the WOL support on Ethernet port x, type **"ethtool ethx"** (x is the port number).

```
Moxa:/# ethtool eth0
Settings for eth0:
      Supported ports: [ TP ]
      Supported link modes:   10baseT/Half 10baseT/Full
                              100baseT/Half 100baseT/Full
                              1000baseT/Full
      Supports auto-negotiation: Yes
      Advertised link modes:  10baseT/Half 10baseT/Full
                              100baseT/Half 100baseT/Full
                              1000baseT/Full
      Advertised auto-negotiation: Yes
      Speed: 100Mb/s
      Duplex: Full
      Port: Twisted Pair
      PHYAD: 0
      Transceiver: internal
      Auto-negotiation: on
      Supports Wake-on: pumbg
      Wake-on: ug
      Current message level: 0x00000033 (51)
      Link detected: yes
Moxa:/#
```

As you can see, the default WOL support is ug (wake on unicast message and Magic packet).

We suggest that you only enable wake up on magic packet. Modify the default setting with the command " ethtool -s ethx wol g".

The following example illustrates how to wake up on suspend (S3):

1. Moxa's embedded computer

   Enable S3 options in BIOS

   Get its MAC by issuing "ifconfig ethx" (x is the port number)

   Suspend to RAM with command "pm-suspend --quirk-s3-bios"

2. Remote computer

   Issue 'etherwake -b mac_of_this_device to wake up it.

For example:

```
etherwake -b 00:90:e8:00:d7:07
```

The following example illustrates how to wake up on shutdown (S5):

1. Moxa's embedded computer

   Shutdown you computer with "shutdown -h now"

2. Remote computer

   Issue 'etherwake -b mac_of_this_device to wake up it.

For example:

```
etherwake -b 00:90:e8:00:d7:07
```

3

Managing Communications

The V2406/2422/2426-LX ready-to-run embedded computer is a network-centric platform designed to serve as a front-end for data acquisition and industrial control applications. This chapter describes how to configure the various communication functions supported by the Linux operating system.

This chapter covers the following topics:

- **Detecting Network Interfaces**
- **Changing the Network Settings**
  - Changing the "interfaces" Configuration File
  - Adjusting IP Addresses with "ifconfig"
- **Serial Port Operation Mode**
- **Telnet/FTP Server**
- **DNS Client**
- **Apache Web Server**
  - Default Homepage
  - Disabling the CGI Function
  - Saving Web Pages to a USB Storage Device
- **IPTABLES**
  - IPTABLES Hierarchy
  - IPTABLES Modules
  - Observe and Erase Chain Rules
  - Define Policy for Chain Rules
  - Append or Delete Rules
- **NAT (Network Address Translation)**
  - NAT Example
  - Enabling NAT at Bootup
- **PPP (Point to Point Protocol)**
  - Connecting to a PPP Server over a Simple Dial-up Connection
  - Connecting to a PPP Server over a Hard-wired Link
  - Checking the Connection
  - Setting up a Machine for Incoming PPP Connections
- **PPPoE**
- **NFS (Network File System) Client**
- **SNMP (Simple Network Management Protocol)**
- **OpenVPN**
  - Ethernet Bridging for Private Networks on Different Subnets
  - Ethernet Bridging for Private Networks on the Same Subnet
  - Routed IP

Detecting Network Interfaces

Linux systems use **udevd** to detect new network interfaces, including Ethernet interfaces and wireless interfaces. The result is saved in **/etc/udev/rules.d/70-persistent-net.rules**. The content is similar to the following:

```
# PCI device 0x10ec:0x8168 (r8168)
SUBSYSTEM=="net",               ACTION=="add",               DRIVERS=="?*",
ATTR{address}=="00:90:e8:00:00:20",   ATTR{dev_id}=="0x0",   ATTR{type}=="1",
KERNEL=="eth*", NAME="eth0"

# PCI device 0x10ec:0x8168 (r8168)
SUBSYSTEM=="net",               ACTION=="add",               DRIVERS=="?*",
ATTR{address}=="00:90:e8:00:00:21",   ATTR{dev_id}=="0x0",   ATTR{type}=="1",
KERNEL=="eth*", NAME="eth1"
```

This file shows system has detected two Ethernet interfaces now.

ATTENTION

When replacing or connecting a network interface, the system may keep the old record in /etc/udev/rules.d/70-persistent-net.rules and that cause network interfaces are detected abnormally. To solve this problem, clear the file /etc/udev/rules.d/70-persistent-net.rules and reboot the system.

Changing the Network Settings

The V2406/2422/2426-LX computer has two 10/100 or 10/100/1000 Ethernet ports named LAN1 to LAN2. The default IP addresses and netmasks of the network interfaces are as follows:

	Default IP Address	Netmask
LAN 1	192.168.3.127	255.255.255.0
LAN 2	192.168.4.127	255.255.255.0

These network settings can be modified by changing the **interfaces** configuration file, or they can be adjusted temporarily with the **ifconfig** command.

Changing the "interfaces" Configuration File

1. Type **cd /etc/network** to change directory.

```
MOXA:~# cd /etc/network
```

2. Type **vi interfaces** to edit the network configuration file with **vi** editor. You can configure the V2406/2422/2426-LX's Ethernet ports for static or dynamic (DHCP) IP addresses.

```
MOXA:/etc/network# vi interfaces
```

Static IP Address

As shown in the example shown below, the default static IP addresses can be modified.

```
# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
auto eth0
iface eth0 inet static
       address 192.168.3.127
       netmask 255.255.255.0
       broadcast 192.168.3.255

auto eth1
iface eth1 inet static
       address 192.168.4.127
       netmask 255.255.255.0
       broadcast 192.168.4.255
```

Dynamic IP Address using DHCP

To configure one or both LAN ports to request an IP address dynamically, replace **static** with **dhcp** and then delete the rest of the lines.

```
# The primary network interface
allow-hotplug eth0
iface eth0 inet dhcp
```

After modifying the boot settings of the LAN interface, issue the following command to activate the LAN settings immediately.

 # /etc/init.d/networking restart

```
MOXA:~# /etc/init.d/networking restart
```

Adjusting IP Addresses with "ifconfig"

IP settings can be adjusted during run-time, but the new settings will not be saved to the flash ROM without modifying the file **/etc/network/interfaces**. For example, type the command **# ifconfig eth0 192.168.1.1** to change the IP address of LAN1 to 192.168.1.1.

```
MOXA:~# ifconfig eth0 192.168.1.1
MOXA:~#
```

Serial Port Operation Mode

The V2406/2422/2426-LX computer has 4 serial ports named COM1, COM2, COM3 and COM4.. The ports support RS-232, RS-422, 2-wire RS-485, and 4-wire RS-485 operation modes with baudrate settings up to 921600 bps.

By default, the serial interface is set to RS-232. You can use the **setinterface** command to change the serial port operation mode, as indicated below:

setinterface device-node [interface-no]

device-node: /dev/ttyMn; n = 0,1,2,...
interface-no: [see following table]:

interface-no	Operation Mode
None	Display current setting
0	RS-232
1	2-wire RS-485
2	RS-422
3	4-wire RS-485

For example, use the following commands to set **/dev/ttyM0** to RS-422:

```
MOXA:~# setinterface /dev/ttyM0 2
MOXA:~# setinterface /dev/ttyM0
Now setting is RS422 interface.
MOXA:~#
```

NOTE

The V2422 and V2426 can be used with two expansion modules with eight serial ports. The corresponding device nodes would be from **ttyM8** to **ttyM15**.

Telnet/FTP Server

In addition to supporting Telnet client/server and FTP client/server, the V2406/2422/2426-LX also supports SSH and sftp client/server. To enable or disable the Telnet/ftp server, you need to edit the file **/etc/inetd.conf**.

1. Mount the root file system with write permission.

```
MOXA:~# mount -o remount,rw /dev/hda1 /
```

2. Type **# cd /etc** to change the directory.

```
MOXA:~# cd /etc
```

3. Type **# vi inetd.conf** to edit the configuration file.

```
MOXA:/etc# vi inetd.conf
```

Enabling the Telnet/FTP Server

The following example shows the default content of the file **/etc/inetd.conf**. The default is to "enable the Telnet/ftp server:"

```
discard dgram udp wait root /bin/discard
discard stream tcp nowait root /bin/discard
telnet stream tcp nowait root /bin/telnetd
ftp stream tcp nowait root /bin/ftpd -l
```

Disabling the Telnet/FTP Server

Disable the daemon by typing "#" in front of the first character of the row to comment out the line. For example, to disable the **FTP** server, use the following commands:

```
discard dgram udp wait root /bin/discard
discard stream tcp nowait root /bin/discard
telnet stream tcp nowait root /bin/telnetd
#ftp stream tcp nowait root /bin/ftpd -l
```

After you finish writing or modifying the code, remember to execute "umount /" to change the root directory back to Read-only mode.

```
MOXA:~# umount /
```

DNS Client

The V2406/2422/2426-LX supports DNS client (but not DNS server). To set up DNS client, you need to edit three configuration files: **/etc/hostname, /etc/resolv.conf,** and **/etc/nsswitch.conf**.

/etc/hostname

1. Mount the root file system with write permission.

```
MOXA:~# mount -o remount,rw /dev/hda1 /
```

2. Edit **/etc/hostname**:

```
MOXA:~# vi /etc/hostname
MOXA
```

3. After you finish writing or modifying the code, remember to execute "umount /" to change the root directory back to Read-only mode.

```
MOXA:~# umount /
```

4. Re-configure the hostname.

```
MOXA:~# /etc/init.d/hostname.sh start
```

5. Check the new hostname.

```
MOXA:~# hostname
```

/etc/resolv.conf

This is the most important file that you need to edit when using DNS. For example, before you using **# ntpdate time.stdtime.gov.tw** to update the system time, you will need to add the DNS server address to the file. Ask your network administrator which DNS server address you should use. The DNS server's IP address is specified with the **nameserver** command. For example, add the following line to /etc/resolv.conf (assuming the DNS server's IP address is 168.95.1.1):

nameserver 168.95.1.1

```
MOXA:/etc# cat resolv.conf
#
# resolv.conf  This file is the resolver configuration file
# See resolver(5).
#
#nameserver 192.168.1.16
nameserver 168.95.1.1
nameserver 140.115.1.31
nameserver 140.115.236.10
MOXA:/etc#
```

/etc/nsswitch.conf

This file defines the sequence of files, **/etc/hosts** or **/etc/resolv.conf**, to be read to resolve the IP address.

The **hosts** line in **/etc/nsswitch.conf** means use **/etc/host** first and DNS service to resolve the address.

```
# /etc/nsswitch.conf
#
# Example configuration of GNU Name Service Switch
functionality.
# If you have the `glibc-doc-reference' and `info' packages
installed, try:
# `info libc "Name Service Switch"' for information about this
file.

passwd:         compat
group:          compat
shadow:         compat

hosts:          files dns
networks:       files

protocols:      db files
services:       db files
ethers:         db files
rpc:            db files

netgroup:       nis
```

Apache Web Server

Default Homepage

The Apache web server's main configuration file is **/etc/apache2/sites-enabled/000-default**, with the default homepage located at **/var/www/apache2-default/index.html**.

Save your own homepage to the following directory:

/var/www/apache2-default

Save your CGI page to the following directory:

/var/www/apache2-default/cgi-bin/

Before you modify the homepage, use a browser (such as Microsoft Internet Explore or Mozilla Firefox) from your PC to test if the Apache web server is working. Type the LAN1 IP address in the browser's address box to open the homepage. For example, if the default IP address 192.168.3.127 is still active, type:

http://192.168.3.127/

To test the default CGI page, type:

http://192.168.3.127/cgi-bin/w3mmail.cgi

Disabling the CGI Function

The CGI function is enabled by default. If you want to disable the function, modify the file **/etc/apache2/sites-enabled/000-default**.

1. Mount the root file system with write permission.

```
MOXA:~# mount -o remount,rw
```

2. Type **# vi/etc/apache2/sites-enabled/000-default** to edit the configuration file.

   Comment on the following lines:

   #ScriptAlias /cgi-bin/ /var/www/apache2-default/cgi-bin/
   #<Directory "/var/www/apache2 default/cgi-bin/">
   # AllowOverride None
   # Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
   # #Order allow,deny
   # Order deny,allow
   # Allow from all
   #</Directory>

```
MOXA:/etc# vi /etc/apache2/sites-available/default
#ScriptAlias /cgi-bin/ /var/www/apache2-default/cgi-bin/
#<Directory "/var/www/apache2 default/cgi-bin/">
#     AllowOverride None
#     Options ExecCGI -MultiViews +SymLinksIFOwnerMatch
#     #Order allow,deny
#     Order deny,allow
#     Allow from all
#</Directory>
```

3. After you finish writing or modifying the code, remember to execute "umount /" to change the root directory back to Read-only mode.

```
MOXA:~# umount /
```

4. Re-start the apache server.

```
MOXA:~# /etc/init.d/apache2 restart
```

ATTENTION

When you develop your own CGI application, make sure your CGI file is executable.

Saving Web Pages to a USB Storage Device

Some applications may have web pages that take up a lot of storage space. This section describes how to save web pages to the USB mass storage device, and then configure the Apache web server's DocumentRoot to open these pages. The files used in this example can be downloaded from Moxa's website.

1. Prepare the web pages and then save the pages to the USB storage device. Click on the following link to download the web page test suite: **http://www.w3.org/MarkUp/Test/HTML401.zip**.
2. Uncompress the zip file to your desktop PC, and then use FTP to transfer it to the V2406/2422/2426-LX's **/media/usb0** directory.
3. Mount the root file system with write permission.

```
MOXA:~# mount -o remount,rw /dev/hda1 /
```

4. Type **# vi/etc/apache2/sites-enabled/000-default** to edit the configuration file.

```
MOXA:/etc# vi /etc/apache2/sites-enabled/000-default
```

5. Change the DocumentRoot directory to the USB storage directory **/media/usb0/www**.

```
...
<VirtualHost *:80>
...
...
       DocumentRoot /media/usb0/www
       <Directory />
              Options FollowSymLinks
              AllowOverride None
       </Directory>
...
...
       ScriptAlias /cgi-bin/ /media/usb0/www/cgi-bin/
       <Directory "/media/usb0/www/cgi-bin/">
              AllowOverride None
              Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
              Order allow,deny
              Allow from all
       </Directory>
...
</VirtualHost>
...
<VirtualHost *:443>
...
...
       DocumentRoot /media/usb0/www
       <Directory />
              Options FollowSymLinks
              AllowOverride None
       </Directory>
...
...
       ScriptAlias /cgi-bin/ /media/usb0/www/cgi-bin/
       <Directory "/media/usb0/wwwz/cgi-bin/">
              AllowOverride None
              Options ExecCGI -MultiViews +SymLinksIfOwnerMatch
              Order allow,deny
              Allow from all
       </Directory>
...
</VirtualHost>
```

6. Use the following commands to restart the Apache web server:

   #cd /etc/init.d
   #./apache2 restart

7. Open your browser and connect to the V2406/2422/2426-LX by typing the current LAN1 IP address in the browser's address box.
8. After finishing modification or writing, remember to execute "umount /" to change the root directory back to Read-only mode.

```
MOXA:~# umount /
```

9. Re-start the apache server.

```
MOXA:~# /etc/init.d/apache2 restart
```

ATTENTION

Visit the Apache website at http://httpd.apache.org/docs/ for more information about setting up Apache servers.

IPTABLES

IPTABLES is an administrative tool for setting up, maintaining, and inspecting the Linux kernel's IP packet filter rule tables. Several different tables are defined, with each table containing built-in chains and user-defined chains.

Each chain is a list of rules that apply to a certain type of packet. Each rule specifies what to do with a matching packet. A rule (such as a jump to a user-defined chain in the same table) is called a **target**.

The V2406/2422/2426-LX supports three types of IPTABLES: Filter tables, NAT tables, and Mangle tables.

Filter Table—includes three chains:

INPUT chain
OUTPUT chain
FORWARD chain

NAT Table—includes three chains:

PREROUTING chain—transfers the destination IP address (DNAT).

POSTROUTING chain—works after the routing process and before the Ethernet device process to transfer the source IP address (SNAT).

OUTPUT chain—produces local packets.

Sub-tables

Source NAT (SNAT)—changes the first source IP address of the packet.

Destination NAT (DNAT)—changes the first destination IP address of the packet.

MASQUERADE—a special form for SNAT. If one host can connect to the Internet, then the other computers that connect to this host can connect to the Internet when the computer does not have an actual IP address.

REDIRECT—a special form of DNAT that re-sends packets to a local host independent of the destination IP address.

Mangle Table—includes two chains

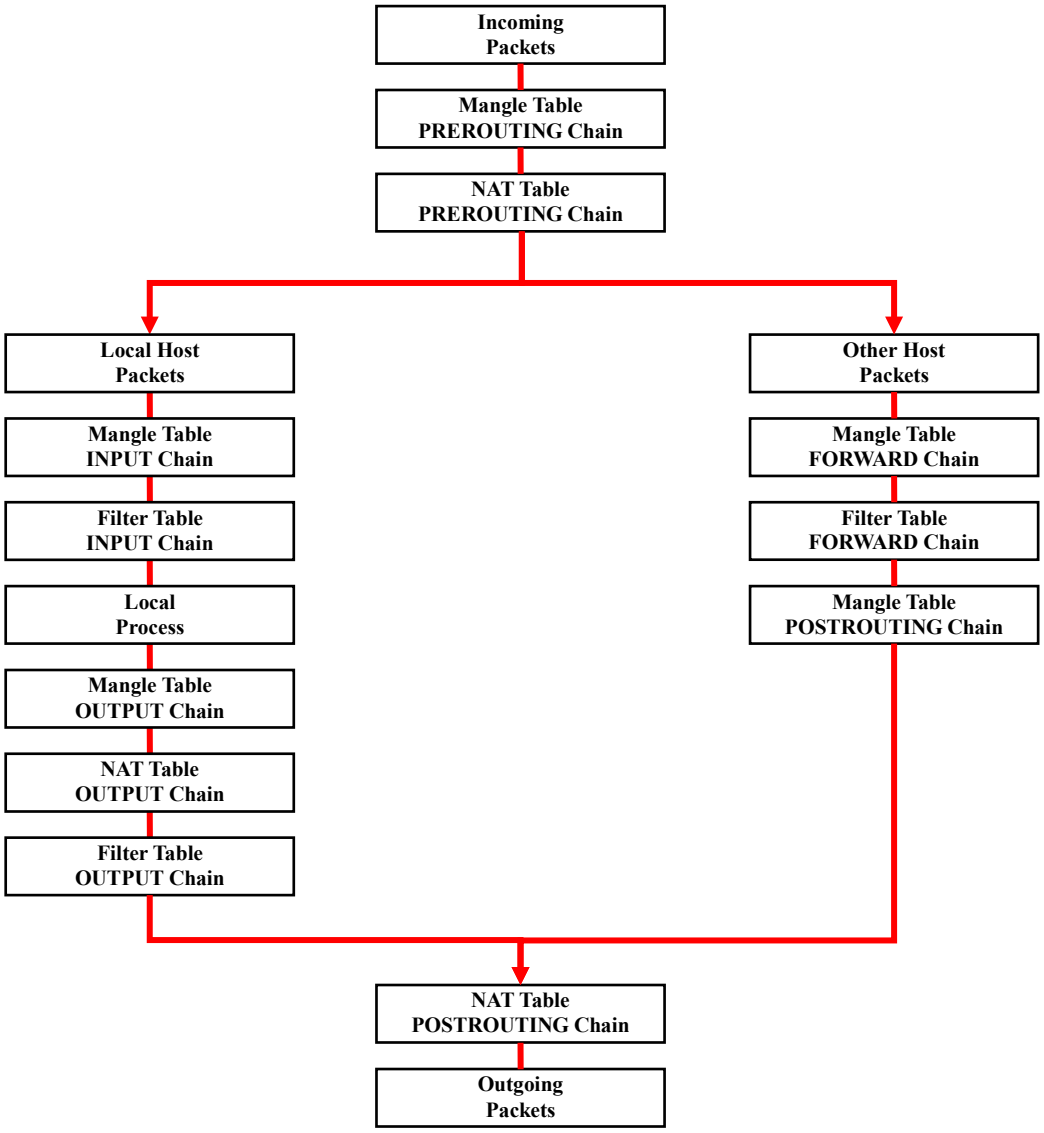
PREROUTING chain—pre-processes packets before the routing process.

OUTPUT chain—processes packets after the routing process.

Mangle tables can have one of three extensions—TTL, MARK, TOS.

IPTABLES Hierarchy

The following figure shows the IPTABLES hierarchy.



IPTABLES Modules

V2406/2422/2426-LX supports the following sub-modules. Be sure to use the module that matches your application.

arptable_filter.ko	arp_tables.ko	arpt_mangle.ko	ip_conntrack_amanda.ko
ip_conntrack_ftp.ko	ip_conntrack_h323.ko	ip_conntrack_irc.ko	ip_conntrack.ko
ip_conntrack_netbios_ns.ko	ip_conntrack_netlink.ko	ip_conntrack_pptp.ko	ip_conntrack_proto_sctp.ko
ip_conntrack_sip.ko	ip_conntrack_tftp.ko	ip_nat_amanda.ko	ip_nat_ftp.ko
ip_nat_h323.ko	ip_nat_irc.ko	ip_nat.ko	ip_nat_pptp.ko
ip_nat_sip.ko	ip_nat_snmp_basic.ko	ip_nat_tftp.ko	ip_queue.ko
iptable_filter.ko	iptable_mangle.ko	iptable_nat.ko	iptable_raw.ko
ip_tables.ko	ipt_addrtype.ko	ipt_ah.ko	ipt_CLUSTERIP.ko
ipt_dscp.ko	ipt_DSCP.ko	ipt_ecn.ko	ipt_ECN.ko
ipt_hashlimit.ko	ipt_iprange.ko	ipt_LOG.ko	ipt_MASQUERADE.ko
ipt_NETMAP.ko	ipt_owner.ko	ipt_recent.ko	ipt_REDIRECT.ko
ipt_REJECT.ko	ipt_SAME.ko	ipt_TCPMSS.ko	ipt_tos.ko
ipt_TOS.ko	ipt_ttl.ko	ipt_TTL.ko	ipt_ULOG.ko

The basic syntax to enable and load an IPTABLES module is as follows:

 # lsmod
 # modprobe ip_tables
 # modprobe iptable_filter
#modprobe iptable_mangle
#modprobe iptable_nat

Use **lsmod** to check if the **ip_tables** module has already been loaded in the V2406/2422/2426-LX. Use **modprobe** to insert and enable the module.

Use **iptables, iptables-restore, iptables-save** to maintain the database.

ATTENTION

IPTABLES plays the role of packet filtering or NAT. Be careful when setting up the IPTABLES rules. If the rules are not correct, remote hosts that connect via a LAN or PPP may be denied. We recommend using the VGA console to set up the IPTABLES. Click on the following links for more information about IPTABLES.

http://www.linuxguruz.com/iptables/
http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html

Since the IPTABLES command is very complex, to illustrate the IPTABLES syntax we have divided our discussion of the various rules into three categories: Observe and erase chain rules, Define policy rules, and Append or delete rules.

Observe and Erase Chain Rules

Usage:

 # iptables [-t tables] [-L] [-n]

-t tables: Table to manipulate (default: 'filter'); example: nat or filter.
-L [chain]: List List all rules in selected chains. If no chain is selected, all chains are listed.
-n: Numeric output of addresses and ports.

 # iptables [-t tables] [-FXZ]

-F: Flush the selected chain (all the chains in the table if none is listed).
-X: Delete the specified user-defined chain.
-Z: Set the packet and byte counters in all chains to zero.

Examples:

 # iptables -L -n

In this example, since we do not use the -t parameter, the system uses the default "filter" table. Three chains are included: INPUT, OUTPUT, and FORWARD. INPUT chains are accepted automatically, and all connections are accepted without being filtered.

 # iptables –F
 # iptables –X
 # iptables -Z

Define Policy for Chain Rules

Usage:

 # iptables [-t tables] [-P] [INPUT, OUTPUT, FORWARD, PREROUTING, OUTPUT, POSTROUTING] [ACCEPT, DROP]

-P: Set the policy for the chain to the given target.
INPUT: For packets coming into the V2406/2422/2426-LX.
OUTPUT: For locally-generated packets.
FORWARD: For packets routed out through the V2406/2422/2426-LX.
PREROUTING: To alter packets as soon as they come in.
POSTROUTING: To alter packets as they are about to be sent out.

Examples:

#iptables –P INPUT DROP
#iptables –P OUTPUT ACCEPT
#iptables –P FORWARD ACCEPT
#iptables –t nat –P PREROUTING ACCEPT
#iptables –t nat –P OUTPUT ACCEPT
#iptables -t nat –P POSTROUTING ACCEPT

In this example, the policy accepts outgoing packets and denies incoming packets.

Append or Delete Rules

Usage:

 # iptables [-t table] [-AI] [INPUT, OUTPUT, FORWARD] [-io interface] [-p tcp, udp, icmp, all] [-s IP/network] [--sport ports] [-d IP/network] [--dport ports] –j [ACCEPT. DROP]

-A: Append one or more rules to the end of the selected chain.
-I: Insert one or more rules in the selected chain as the given rule number.
-i: Name of an interface via which a packet is going to be received.
-o: Name of an interface via which a packet is going to be sent.
-p: The protocol of the rule or of the packet to check.
-s: Source address (network name, host name, network IP address, or plain IP address).
--sport: Source port number.
-d: Destination address.
--dport: Destination port number.
-j: Jump target. Specifies the target of the rules; i.e., how to handle matched packets.

For example, ACCEPT the packet, DROP the packet, or LOG the packet.

Examples:

Example 1: Accept all packets from the lo interface.

 # iptables –A INPUT –i lo –j ACCEPT

Example 2: Accept TCP packets from 192.168.0.1.

 # iptables –A INPUT –i eth0 –p tcp –s 192.168.0.1 –j ACCEPT

Example 3: Accept TCP packets from Class C network 192.168.1.0/24.

 # iptables –A INPUT –i eth0 –p tcp –s 192.168.1.0/24 –j ACCEPT

Example 4: Drop TCP packets from 192.168.1.25.

 # iptables –A INPUT –i eth0 –p tcp –s 192.168.1.25 –j DROP

Example 5: Drop TCP packets addressed for port 21.

 # iptables –A INPUT –i eth0 –p tcp --dport 21 –j DROP

Example 6: Accept TCP packets from 192.168.0.24 to V2101-I-LX's port 137, 138, 139

 # iptables –A INPUT –i eth0 –p tcp –s 192.168.0.24 --dport 137:139 –j ACCEPT

Example 7: Log TCP packets that visit V2101-I-LX's port 25.

 # iptables –A INPUT –i eth0 –p tcp --dport 25 –j LOG

Example 8: Drop all packets from MAC address 01:02:03:04:05:06.

 # iptables –A INPUT –i eth0 –p all –m mac --mac-source 01:02:03:04:05:06 –j DROP

ATTENTION

In Example 8, remember to issue the command **# modprobe ipt_mac** first to load the module **ipt_mac**.

NAT (Network Address Translation)

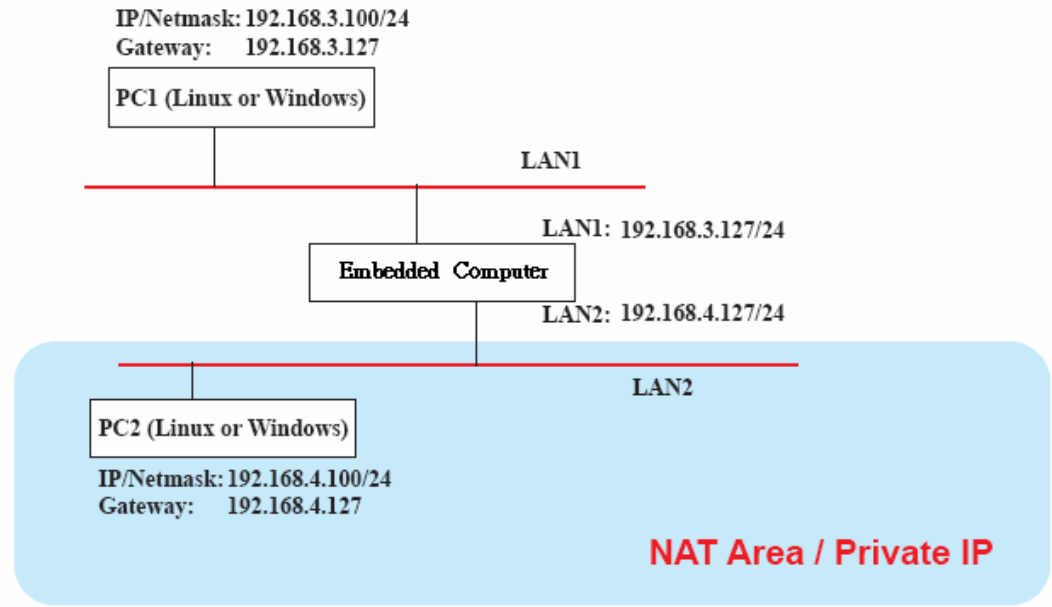
The NAT (Network Address Translation) protocol translates IP addresses used on one network into IP addresses used on a connecting network. One network is designated the inside network and the other is the outside network. Typically, the V2406/2422/2426-LX connects several devices on a network and maps local inside network addresses to one or more global outside IP addresses, and un-maps the global IP addresses on incoming packets back into local IP addresses.

ATTENTION

Click on the following links for more information about NAT.
http://www.netfilter.org/documentation/HOWTO//packet-filtering-HOWTO.html

NAT Example

The IP address of all packets leaving LAN1 are changed to **192.168.3.127** (you will need to load the module **ipt_MASQUERADE**):



Enabling NAT at Bootup

In most real world situations, you will want to use a simple shell script to enable NAT when the V2406/2422/2426-LX boots up. The following script is an example.

```
#!/bin/bash
# If you put this shell script in the /home/nat.sh
# Remember to chmod 744 /home/nat.sh
# Edit the rc.local file to make this shell startup automatically.
# vi /etc/rc.local
# Add a line in the end of rc.local /home/nat.sh

EXIF= "eth0"    #This is an external interface for setting up a valid IP address.
EXNET= "192.168.4.0/24"    #This is an internal network address.

# Step 1. Insert modules.
```

```
# Here 2> /dev/null means the standard error messages will be dump to null device.

modprobe ip_tables    2> /dev/null
modprobe ip_nat_ftp    2> /dev/null
modprobe ip_nat_irc    2> /dev/null
modprobe ip_conntrack    2> /dev/null
modprobe ip_conntrack_ftp    2> /dev/null
modprobe ip_conntrack_irc    2> /dev/null

# Step 2. Define variables, enable routing and erase default rules.

PATH=/bin:/sbin:/usr/bin:/usr/sbin:/usr/local/bin:/usr/local/sbin
export PATH
echo "1" > /proc/sys/net/ipv4/ip_forward
/sbin/iptables -F
/sbin/iptables -X
/sbin/iptables -Z
/sbin/iptables -F -t nat
/sbin/iptables -X -t nat
/sbin/iptables -Z -t nat
/sbin/iptables -P INPUT ACCEPT
/sbin/iptables -P OUTPUT ACCEPT
/sbin/iptables -P FORWARD ACCEPT
/sbin/iptables -t nat -P PREROUTING ACCEPT
/sbin/iptables -t nat -P POSTROUTING ACCEPT
/sbin/iptables -t nat -P OUTPUT ACCEPT

# Step 3. Enable IP masquerade.

#ehco 1 > /proc/sys/net/ipv4/ip_forward#modprobe ipt_MASQUERADE#iptables –t nat –A
POSTROUTING –o eth0 –j MASQUERADE
```

PPP (Point to Point Protocol)

PPP (Point to Point Protocol) is used to run IP (Internet Protocol) and other network protocols over a serial link. PPP can be used for direct serial connections (using a null-modem cable) over a Telnet link, and links established using a modem over a telephone line.

Modem/PPP access is almost identical to connecting directly to a network through the V2406/2422/2426-LX Ethernet port. Since PPP is a peer-to-peer system, the V2406/2422/2426-LX can also use PPP to link two networks (or a local network to the Internet) to create a Wide Area Network (WAN).

ATTENTION

Click on the following links for more information about PPP.

http://tldp.org/HOWTO/PPP-HOWTO/index.html
http://axion.physics.ubc.ca/ppp-linux.html

Connecting to a PPP Server over a Simple Dial-up Connection

The following command is used to connect to a PPP server by modem. Use this command for old ppp servers that prompt for a login name (replace "username" with the correct name) and password (replace "password" with the correct password). Note that "debug crtscts" and "defaultroute 192.1.1.17" are optional.

#pppd connect 'chat -v "" ATDT5551212 CONNECT ""' ogin: username word: password' /dev/ttyS0 115200 debug crtscts modem defaultroute 192.1.1.17

If the PPP server does not prompt for the username and password, the command should be entered as follows. Replace "username" with the correct username and replace "password" with the correct password.

#pppd connect 'chat -v "" ATDT5551212 CONNECT ""' user username password password /dev/ttyS0 115200 crtscts modem

The pppd options are described below:

connect 'chat etc...' This option gives the command to contact the PPP server. The **chat** program is used to dial a remote computer. The entire command is enclosed in single quotes because pppd expects a one-word argument for the **connect** option. The options for **chat** are given below:

-v verbose mode; log what we do to syslog

" " Double quotes—don't wait for a prompt, but instead do ... (Note that you must include a space after the second quotation mark)

ATDT5551212 Dial the modem, and then ...

CONNECT Wait for an answer.

" " Send a return (null text followed by the usual return)

ogin: username word: password
Log in with username and password.

Refer to the chat man page, chat.8, for more information about the **chat** utility.

/dev/ Specify the callout serial port.

115200 The baud rate.

debug Log status in syslog.

crtscts Use hardware flow control between computer and modem (at 115200 this is a must).

modem Indicates that this is a modem device; pppd will hang up the phone before and after making the call.

defaultroute Once the PPP link is established, make it the default route; if you have a PPP link to the Internet, this is probably what you want.

192.1.1.17 This is a degenerate case of a general option of the form x.x.x.x:y.y.y.y. Here x.x.x.x is the local IP address and y.y.y.y is the IP address of the remote end of the PPP connection. If this option is not specified, or if just one side is specified, then x.x.x.x defaults to the IP address associated with the local machine's hostname (located in /**etc/hosts**), and y.y.y.y is determined by the remote machine.

Connecting to a PPP Server over a Hard-wired Link

If a username and password are not required, use the following command (note that **noipdefault** is optional):

#pppd connect 'chat –v" " " " ' noipdefault /dev/tty 19200 crtscts

If a username and password is required, use the following command (note that **noipdefault** is optional, and root is both the username and password):

#pppd connect 'chat –v" " " " ' user root password root noipdefault /dev/ttyS0 19200 crtscts

Checking the Connection

Once you have set up a PPP connection, there are some steps you can take to test the connection. First, type:

#/sbin/ifconfig

Depending on your distribution, the command might be located elsewhere. After executing the command, you should be able to see all of the network interfaces that are UP.

ppp0 should be one of them, and you should recognize the first IP address as your own and the **P-t-P address** (point-to-point address, the address of your server). The output is similar to the following:

```
lo      Link encap Local Loopback
        inet addr 127.0.0.1   Bcast 127.255.255.255 Mask
255.0.0.0
        UP LOOPBACK RUNNING   MTU 2000   Metric 1
        RX packets 0 errors 0 dropped 0 overrun 0

ppp0    Link encap Point-to-Point Protocol
        inet addr 192.76.32.3   P-t-P 129.67.1.165 Mask
255.255.255.0
        UP POINTOPOINT RUNNING   MTU 1500   Metric 1
        RX packets 33 errors 0 dropped 0 overrun 0
        TX packets 42 errors 0 dropped 0 overrun 0
```

Now, type:

#ping z.z.z.z

where z.z.z.z is the address of your name server. The output is similar to the following:

```
MOXA:~# ping 129.67.1.165
PING 129.67.1.165 (129.67.1.165): 56 data bytes
64 bytes from 129.67.1.165: icmp_seq=0 ttl=225 time=268 ms
64 bytes from 129.67.1.165: icmp_seq=1 ttl=225 time=247 ms
64 bytes from 129.67.1.165: icmp_seq=2 ttl=225 time=266 ms
^C
--- 129.67.1.165 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 247/260/268 ms
MOXA:~#
```

Try typing:

#netstat -nr

This should show three routes similar to the following:

```
Kernel routing table
Destination   Gateway    Genmask         Flags   Metric  Ref Use
iface
129.67.1.165  0.0.0.0    255.255.255.255 UH      0       0   6
ppp0
127.0.0.0     0.0.0.0    255.0.0.0       U       0       0   0 lo
0.0.0.0       129.67.1.165  0.0.0.0     UG      0       0   6298
ppp0
```

If your output looks similar but does not have the "destination 0.0.0.0" line (which refers to the default route used for connections), you may have run pppd without the **defaultroute** option. At this point, you can try using Telnet, ftp, or finger, bearing in mind that you will have to use numeric IP addresses unless you have configured **/etc/resolv.conf** correctly.

Setting up a Machine for Incoming PPP Connections

Method 1: pppd dial-in with pppd commands

This first example applies to using a modem, and requiring authorization with a username and password.

#pppd /dev/ttyS0 115200 crtscts modem 192.168.16.1:192.168.16.2 login auth

You should also add the following line to the file **/etc/ppp/pap-secrets**:

*** * "" ***

The first star (*) lets everyone login. The second star (*) lets every host connect. The pair of double quotation marks ("") indicates that the file **/etc/passwd** can be used to check the password. The last star (*) is to let any IP connect.

The following example does not check the username and password:

 # pppd/dev/ttyS0 115200 crtscts modem 192.168.16.1:192.168.16.2

Method 2: pppd dial-in with pppd script

Configure a dial-in script **/etc/ppp/peer/dialin**

```
# You usually need this if there is no PAP authentication
noauth
#auth
#login

# The chat script (be sure to edit that file, too!)
init "/usr/sbin/chat -v -f /etc/ppp/ppp-ttyM0.chat"

# Set up routing to go through this PPP link
defaultroute

# Default modem (you better replace this with /dev/ttySx!)
/dev/ttyM0

# Speed
115200

# Keep modem up even if connection fails
persist
crtscts
modem
192.168.16.1:192.168.16.2
debug
-detach
```

Configure the chat script **/etc/ppp/ppp-ttyM0.chat**

```
SAY     'Auto Answer ON\n'
''      ATS0=1
```

Start the **pppd** dial-in service.

```
# pppd call dialin
```

ATTENTION

If you hope to have auto dial-in service, you can respawn the dial-in service in **/etc/inittab**.

```
MOXA:~# mount -o remount,rw /dev/hda1 /
MOXA:~# echo "p0:2345:respawn:pppd call dialin" >>
/etc/inittab
MOXA:~# umount /
```

PPPoE

The following procedure is for setting up PPPoE:

1. Connect the V2406/2422/2426-LX's LAN port to an ADSL modem with a cross-over cable, HUB, or switch.
2. Log in to the V2406/2422/2426-LX's as the root user.
3. Edit the file **/etc/ppp/chap-secrets** and add the following:
   "username@hinet.net" * "password" *

```
# Secrets for authentication using CHAP
# client        server  secret                  IP addresses

# PPPOE example, if you want to use it, you need to unmark it
and modify it
"username@hinet.net"   *      "password"     *
```

username@hinet.net is the username obtained from the ISP to log in to the ISP account.
password is the corresponding password for the account.

4. Edit the file **/etc/ppp/pap-secrets** and add the following:
   "username@hinet.net" * "password" *

```
# ATTENTION: The definitions here can allow users to login
without a
# password if you don't use the login option of pppd! The
mgetty Debian
# package already provides this option; make sure you don't
change that.

# INBOUND connections

# Every regular user can use PPP and has to use passwords
from /etc/passwd
*      hostname       ""     *
"username@hinet.net"    *      "password"     *

# UserIDs that cannot use PPP at all. Check your /etc/passwd
and add any
# other accounts that should not be able to use pppd!
guest   hostname       "*"    -
master  hostname       "*"    -
root    hostname       "*"    -
support hostname       "*"    -
stats   hostname       "*"    -

# OUTBOUND connections
```

username@hinet.net is the username obtained from the ISP to log in to the ISP account.
password is the corresponding password for the account.

5. Edit the file **/etc/ppp/options** and add the following line:
   plugin rp-pppoe

```
# received.  Note: it is not advisable to use this option
with the persist
# option without the demand option.  If the active-filter
option is given,
# data packets which are rejected by the specified activity
filter also
# count as the link being idle.
#idle <n>

# Specifies how many seconds to wait before re-initiating the
link after
# it terminates.  This option only has any effect if the
persist or demand
# option is used.  The holdoff period is not applied if the
link was
# terminated because it was idle.
#holdoff <n>

# Wait for up n milliseconds after the connect script
finishes for a valid
# PPP packet from the peer.  At the end of this time, or when
a valid PPP
# packet is received from the peer, pppd will commence
negotiation by
# sending its first LCP packet.  The default value is 1000 (1
second).
# This wait period only applies if the connect or pty option
is used.
#connect-delay <n>

# Load the pppoe plugin
plugin rp-pppoe.so

# ---<End of File>---
```

6. If you use LAN1 to connect to the ADSL modem, add file **/etc/ppp/options.eth0**. If you use LAN2 to connect to the ADSL modem, then add **/etc/ppp/options.eth1**, etc.

```
name username@hinet.net
mtu 1492
mru 1492
defaultroute
noipdefault
~
~
"/etc/ppp/options.eth0" 5 lines, 67 characters
```

Type your username (the one you set in the **/etc/ppp/pap-secrets and /etc/ppp/chap-secrets** files) after the **name** option. You may add other options as desired.

7. Set up DNS.

If you are using DNS servers supplied by your ISP, edit the file **/etc/resolv.conf** by adding the following lines of code:

nameserver ip_addr_of_first_dns_server
nameserver ip_addr_of_second_dns_server

For example:

nameserver 168.95.1.1
nameserver 139.175.10.20

```
MOXA:/etc# cat resolv.conf
#
# resolv.conf  This file is the resolver configuration file
# See resolver(5).
#
nameserver 168.95.1.1
nameserver 139.175.10.20
MOXA:/etc#
```

8. Use the following command to create a **pppoe** connection:
   #pppd eth0

The ADSL modem is connected to the **LAN1** port, which is named **eth0**. If the ADSL modem is connected to **LAN2**, use **eth1**, etc.

9. Type **#ifconfig ppp0** to check if the connection is OK. If the connection is OK, you should see the IP address of ppp0. Use **#ping** to test the IP address.

```
ppp0    Link encap Point-to-Point Protocol
        inet  addr  192.76.32.3      P-t-P  129.67.1.165  Mask
255.255.255.0
        UP POINTOPOINT RUNNING  MTU 1500  Metric 1
        RX packets 33 errors 0 dropped 0 overrun 0
        TX packets 42 errors 0 dropped 0 overrun 0
```

10. If you want to disconnect it, use the kill command to kill the **pppd** process.

NFS (Network File System) Client

The Network File System (NFS) is used to mount a disk partition on a remote machine (as if it were on a local hard drive), allowing fast, seamless sharing of files across a network. NFS allows users to develop applications for the V2406/2422/2426-LX without worrying about the amount of disk space that will be available. The V2406/2422/2426-LX supports only NFS client protocol.

ATTENTION

Click on the following links for more information about NFS.

http://www.ietf.org/rfc/rfc1213.txt
http://www.faqs.org/rfcs/rfc1317.html

The following procedures illustrate how to mount a remote NFS Server.

1. Scan the NFS Server's shared directory.
   #showmount –e HOST
   showmount: Show the mount information of an NFS Server
   -e: Show the NFS Server's export list.
   HOST: IP address or DNS address

2. Establish a mount point on the NFS Client site.
   #mkdir –p /home/nfs/public

3. Mount the remote directory to a local directory.
   # mount -t nfs -o nolock 192.168.3.100:/home/public /home/nfs/public

   This is where 192.168.3.100 is the example IP address of the NFS server.

SNMP (Simple Network Management Protocol)

The V2406/2422/2426-LX comes with the SNMP V1 (Simple Network Management Protocol) agent software pre-installed. It supports **RFC 1213 MIB-II**. The following example shows an SNMP agent responding to a query from the SNMP browser on the host site:

```
***** SNMP QUERY STARTED *****
[root@jaredRH90 root]# snmpwalk -v 1 -c public
192.168.30.128|more
RFC1213-MIB::sysDescr.0 = STRING: "Linux Moxa 2.6.30-bpo.2-
686 #1 SMP Fri Dec 11 18:12:58 UTC 2009 i686"
RFC1213-MIB::sysObjectID.0 = OID: RFC1155-
SMI::enterprises.8691.12.2420
DISMAN-EVENT-MIB::sysUpTimeInstance = Timeticks: (126176)
0:21:01.76
RFC1213-MIB::sysContact.0 = STRING: "\"Jared\""
RFC1213-MIB::sysName.0 = STRING: "Moxa"
RFC1213-MIB::sysLocation.0 = STRING: "\"Fl.8 No.6, Alley 6,
Lane 235, Pao-Chiao Rd., Shing Tien City, Taipei, Taiwan,
R.O.C.\""
SNMPv2-MIB::sysORLastChange.0 = Timeticks: (4) 0:00:00.04
SNMPv2-MIB::sysORID.1 = OID: SNMP-FRAMEWORK-
MIB::snmpFrameworkMIBCompliance
SNMPv2-MIB::sysORID.2 = OID: SNMP-MPD-MIB::snmpMPDCompliance
SNMPv2-MIB::sysORID.3 = OID: SNMP-USER-BASED-SM-
MIB::usmMIBCompliance
SNMPv2-MIB::sysORID.4 = OID: SNMPv2-MIB::snmpMIB
SNMPv2-MIB::sysORID.5 = OID: TCP-MIB::tcpMIB
SNMPv2-MIB::sysORID.6 = OID: RFC1213-MIB::ip
SNMPv2-MIB::sysORID.7 = OID: UDP-MIB::udpMIB
SNMPv2-MIB::sysORID.8 = OID: SNMP-VIEW-BASED-ACM-
MIB::vacmBasicGroup
…
```

ATTENTION

Click on the following links for more information about **RFC1317 RS-232** like group and **RFC 1213 MIB-II**.

http://www.faqs.org/rfcs/rfc1317.html
http://www.ietf.org/rfc/rfc1213.txt

OpenVPN

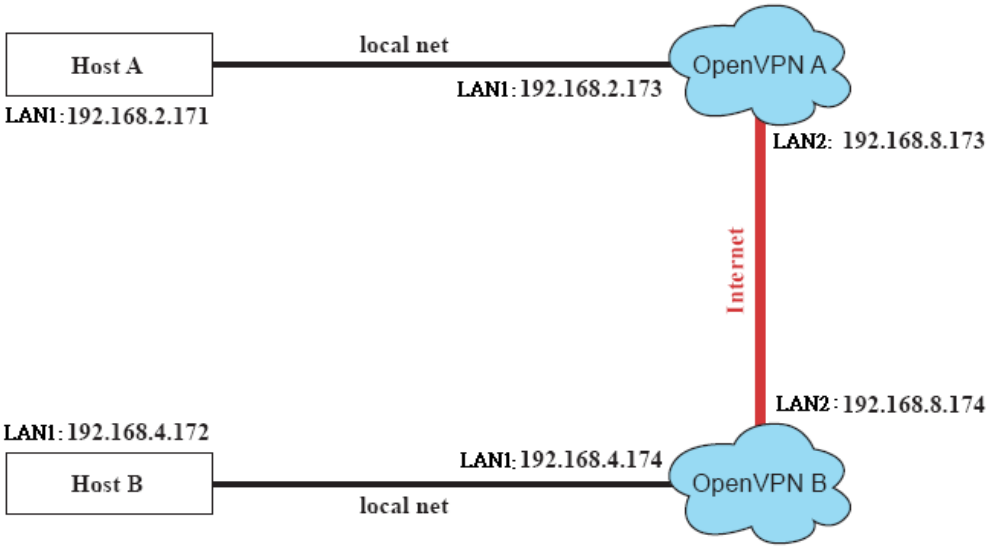
OpenVPN provides two types of tunnels for users to implement VPNS: **Routed IP Tunnels** and **Bridged Ethernet Tunnels**.

An Ethernet bridge is used to connect different Ethernet networks together. The Ethernets are bundled into one bigger, "logical" Ethernet. Each Ethernet corresponds to one physical interface (or port) that is connected to the bridge.

On each OpenVPN machine, you should carry out configurations in the **/etc/openvpn** directory, where script files and key files reside. Once established, all operations will be performed in that directory.

Ethernet Bridging for Private Networks on Different Subnets

1. Set up four machines, as shown in the following diagram.



Host A represents the machine that belongs to OpenVPN A, and Host B represents the machine that belongs to OpenVPN B. The two remote subnets are configured for a different range of IP addresses. When this configuration is moved to a public network, the external interfaces of the OpenVPN machines should be configured for static IPs, or connected to another device (such as a firewall or DSL box) first.

2. Generate a preset shared key by typing the command:
   # openvpn --genkey --secret secrouter.key
3. Copy the file that is generated to the OpenVPN machine:
   # scp /etc/openvpn/secrouter.key 192.168.8.174:/etc/openvpn

ATTENTION

A preshared key is located at **/etc/openvpn/secrouter.key**. You can use it for testing purposes. We suggest creating a new key for non-testing purpose.

4. On machine OpenVPN A, modify the remote address in the configuration file **/etc/openvpn/tap0-br.conf**.

```
# point to the peer
remote 192.168.8.174
dev tap0
port 1194
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
up /etc/openvpn/tap0-br.sh
```

5. Next, modify the routing table in the **/etc/openvpn/tap0-br.sh script** file.

```
#--------------------------Start---------------------------
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.4.0 netmask 255.255.255.0 dev br0
#----------------------------end---------------------------
```

And then configure the bridge interface in **/etc/openvpn/bridge**.

```
#!/bin/bash
# Create global variables
# Define Bridge Interface
br="br0"
# Define list of TAP interfaces to be bridged,
# for example tap="tap0 tap1 tap2".
tap="tap0"
# Define physical ethernet interface to be bridged
# with TAP interface(s) above.
eth="eth1"
eth_ip="192.168.8.173"
eth_netmask="255.255.255.0"
eth_broadcast="192.168.8.255"
#gw="192.168.8.174"
...
```

Start the bridge script file to configure the bridge interface.

 # /etc/openvpn/bridge restart

6. On machine OpenVPN B, modify the remote address in configuration file **/etc/openvpn/tap0-br.conf**.

```
# point to the peer
remote 192.168.8.173
dev tap0
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
up /etc/openvpn/tap0-br.sh
#comp-lzo
```

7. Next modify the routing table in **/etc/openvpn/tap0-br.sh script** file.

```
#----------------------------------Start---------------------
--------
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.2.0 netmask 255.255.255.0 dev br0
#---------------------------------- end ---------------------
--------
```

And then configure the bridge interface in **/etc/openvpn/bridge**.

```
#!/bin/bash
# Create global variables
# Define Bridge Interface
br="br0"
# Define list of TAP interfaces to be bridged,
# for example tap="tap0 tap1 tap2".
tap="tap0"
# Define physical ethernet interface to be bridged
# with TAP interface(s) above.
eth="eth1"
eth_ip="192.168.8.174"
eth_netmask="255.255.255.0"
eth_broadcast="192.168.8.255"
#gw="192.168.8.173"
...
```

Start the bridge script file to configure the bridge interface.

 # /etc/openvpn/bridge restart

ATTENTION

Select cipher and authentication algorithms by specifying **cipher** and **auth**. To see which algorithms are available, type:

 # openvpn --show-ciphers
 # openvpn --show-auths

8. Start both OpenVPN peers on machine OpenVPN A and OpenVPN B.
   # openvpn --config /etc/openvpn/tap0-br.conf&

If you see the line **Peer Connection Initiated with 192.168.8.173:5000**on each machine, the connection between OpenVPN machines has been established successfully on UDP port 5000.

ATTENTION

You can create link symbols to start the OpenVPN service at boot time:
 # ln -sf /etc/init.d/openvpn /etc/rc2.d/S16openvpn

To stop the service, you should create these links:
 # ln -sf /etc/init.d/openvpn /etc/rc0.d/K80openvpn
 # ln -sf /etc/init.d/openvpn /etc/rc6.d/K80openvpn

9. On each OpenVPN machine, check the routing table by typing the command **# route**

```
Destination     Gateway Genmsk          Flags   Metric  Ref
    Use Iface
192.168.5.0     0.0.0.0 255.255.255.0   U       0       0    0
    eth2
192.168.4.0     0.0.0.0 255.255.255.0   U       0       0    0
    br0
192.168.3.0     0.0.0.0 255.255.255.0   U       0       0    0
    eth0
192.168.30.0    0.0.0.0 255.255.255.0   U       0       0    0
    eth3
192.168.8.0     0.0.0.0 255.255.255.0   U       0       0    0
    br0
```

Interface **eth1** and device **tap0** both connect to the bridging interface, and the virtual device **tun** sits on top of **tap0**. This ensures that all traffic coming to this bridge from internal networks connected to interface eth1 write to the TAP/TUN device that the OpenVPN program monitors. Once the OpenVPN program detects traffic on the virtual device, it sends the traffic to its peer.

10. To create an indirect connection to Host B from Host A, you need to add the following routing item:

    # route add –net 192.168.4.0 netmask 255.255.255.0 dev eth0

    To create an indirect connection to Host A from Host B, you need to add the following routing item:

 # route add –net 192.168.2.0 netmask 255.255.255.0 dev eth0

Now ping Host B from Host A by typing:

 # ping 192.168.4.174

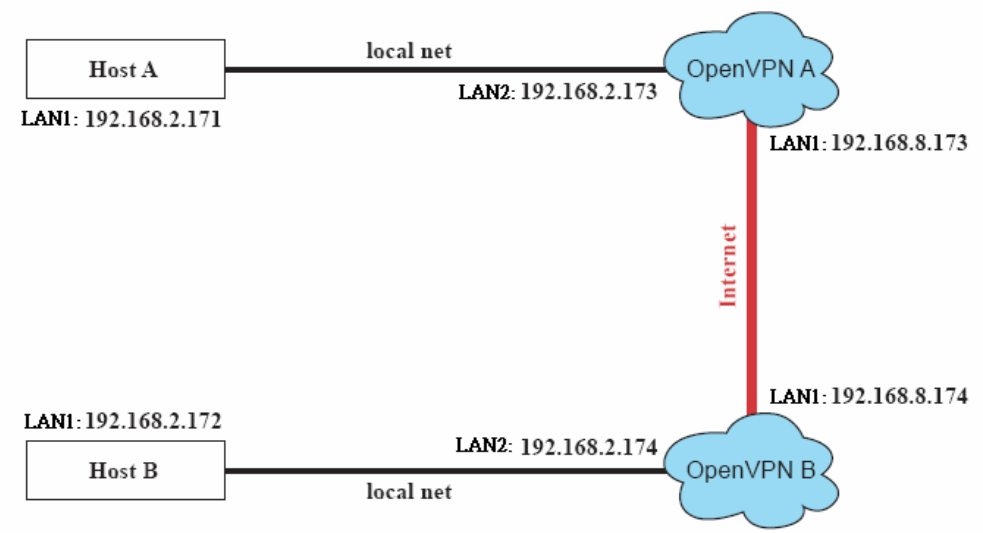
A successful ping indicates that you have created a VPN system that only allows authorized users from one internal network to access users at the remote site. For this system, all data is transmitted by UDP packets on port 5000 between OpenVPN peers.

11. To shut down OpenVPN programs, type the command:

    # killall -TERM openvpn

Ethernet Bridging for Private Networks on the Same Subnet

1. Set up four machines, as shown in the following diagram.

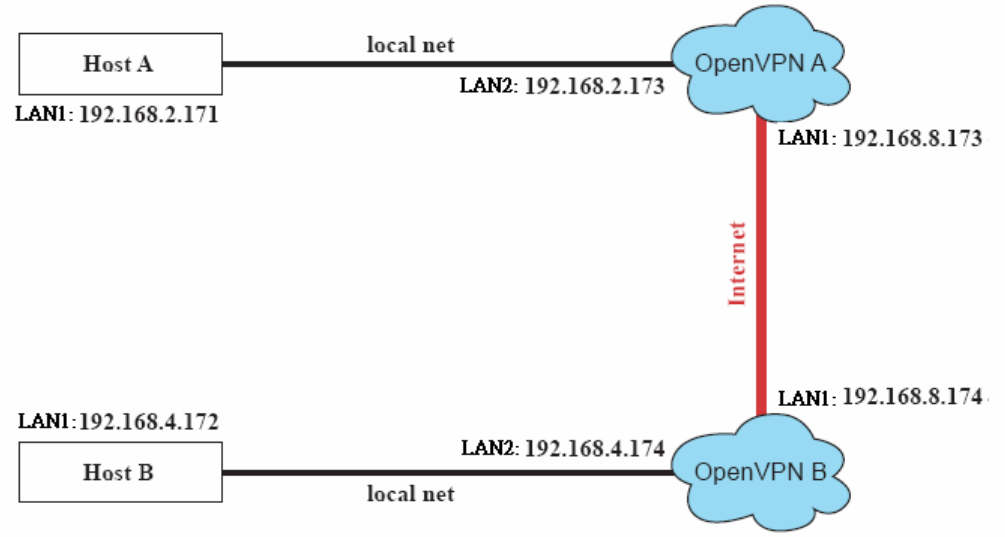


2. The configuration procedure is almost the same as for the previous example. The only difference is that you will need to comment out the parameter **up** in **/etc/openvpn/tap0-br.conf** of OpenVPN A and **/etc/openvpn/tap0-br.conf** of OpenVPN B.

```
# point to the peer
remote 192.168.8.174
dev tap0
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
#up /etc/openvpn/tap0-br.sh
#comp-lzo
```

Routed IP

1. Set up four machines, as shown in the following diagram.



2. On machine OpenVPN A, modify the remote address in configuration file **/etc/openvpn/tun.conf**.

```
# point to the peer
remote 192.168.8.174
dev tun
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
ifconfig 192.168.2.173 192.168.4.174
up /etc/openvpn/tun.sh
```

3. Next, modify the routing table in script file **/etc/openvpn/tun.sh**.

```
#----------------------------Start-----------------------------
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.2.0 netmask 255.255.255.0 gw $5
#-----------------------------end-----------------------------
```

4. On machine OpenVPN B, modify the remote address in configuration file **/etc/openvpn/tun.conf**.

```
# point to the peer
remote 192.168.8.173
dev tun
secret /etc/openvpn/secrouter.key
cipher DES-EDE3-CBC
auth MD5
tun-mtu 1500
tun-mtu-extra 64
ping 40
ifconfig 192.168.4.174 192.168.2.173
up /etc/openvpn/tun.sh
```

And then modify the routing table in script file **/etc/openvpn/tun.sh**.

```
#--------------------------Start-----------------------------
#!/bin/sh
# value after "-net" is the subnet behind the remote peer
route add -net 192.168.2.0 netmask 255.255.255.0 gw $5
#---------------------------end-----------------------------
```

The first argument of parameter **ifconfig** is the local internal interface and the second argument is the internal interface at the remote peer.

$5 is the argument that the OpenVPN program passes to the script file. Its value is the second argument of **ifconfig** in the configuration file.

5. Check the routing table after you run the OpenVPN programs, by typing the command **# route**.

```
Destination     Gateway         Genmsk          Flags   Metric
    Ref Use Iface
192.168.4.174   *               255.255.255.255 UH      0
    0   0   tun0
192.168.4.0     192.168.4.174   255.255.255.0   UG      0
    0   0   tun0
192.168.2.0     *               255.255.255.0   U       0
    0   0   eth1
192.168.8.0     *               255.255.255.0   U       0
    0   0   eth0
```

4

Programming Guide

This chapter covers the following topics:

- **Device API**
- **RTC (Real Time Clock)**
- **UART**
- **Digital I/O**
- **WDT (Watch Dog Timer)**

Device API

The V2406/2422/2426-LX supports control devices with the **ioctl** system API. The interface is shown as below.

```
int ioctl(int d, int request,…);
```

Input:

<d> open device node return file handle

<request> argument in or out

Refer to desktop Linux's man page for detailed documentation:

```
#man ioctl
```

RTC (Real Time Clock)

The device node is located at **/dev/rtc**. The V2406/2422/2426-LX supports standard Linux simple RTC control. You must include **<linux/rtc.h>**.

1. Function: RTC_RD_TIME

```
int ioctl(fd, RTC_RD_TIME, struct rtc_time *time);
```

Description: read time information from RTC. It will return the value on argument 3.

2. Function: RTC_SET_TIME

```
int ioctl(fd, RTC_SET_TIME, struct rtc_time *time);
```

Description: set RTC time. Argument 3 will be passed to RTC.

UART

The normal tty device node is **/dev/ttyS0** and **/det/ttyS1**.

The V2406/2422/2426-LX supports standard Linux termios control with RS-232/422/485 serial ports.

To configure the serial ports, follow these steps.

1. You must include **"moxadevice.h**", which you can find in the folder \example\moxalib in CD.

```
#define RS232_MODE 0
#define RS485_2WIRE_MODE 1
#define RS422_MODE 2
#define RS485_4WIRE_MODE 3
```

2. Function: MOXA_SET_OP_MODE

int ioctl(fd, MOXA_SET_OP_MODE, &mode)

Description Set the interface mode. Argument 3 mode will pass to the UART device driver and change it.

3. Function: MOXA_GET_OP_MODE

int ioctl(fd, MOXA_GET_OP_MODE, &mode)

Description Get the interface mode. Argument 3 mode will return the interface mode.

There are two Moxa private ioctl control definitions for setting up special baudrates.

MOXA_SET_SPECIAL_BAUD_RATE

MOXA_GET_SPECIAL_BAUD_RATE

If you use this ioctl to set a special baudrate, the termios cflag will be B4000000, in which case the B4000000 define will be different. If the baudrate you get from termios (or from calling tcgetattr()) is B4000000, you must call ioctl with MOXA_GET_SPECIAL_BAUD_RATE to get the actual baudrate.

Example to set the baudrate

```
#include "moxadevice.h"
#include <termios.h>
struct termios term;
int fd, speed;
fd = open("/dev/ttyS0", O_RDWR);
tcgetattr(fd, &term);
term.c_cflag &= ~(CBAUD | CBAUDEX);
term.c_cflag |= B4000000;
tcsetattr(fd, TCSANOW, &term);
speed = 500000;
ioctl(fd, MOXA_SET_SPECIAL_BAUD_RATE, &speed);
```

Example to get the baudrate

```
#include "moxadevice.h"
#include <termios.h>
struct termios term;
int fd, speed;
fd = open("/dev/ttyS0", O_RDWR);
tcgetattr(fd, &term);
if ( (term.c_cflag & (CBAUD|CBAUDEX)) != B4000000 ) {
// follow the standard termios baud rate define
} else {
ioctl(fd, MOXA_GET_SPECIAL_BAUD_RATE, &speed);
}
```

Baudrate inaccuracy

Divisor = 921600/Target Baud Rate. (Only Integer part)

ENUM = 8 * (921600/Target - Divisor) (Round up or down)

Inaccuracy =((Target Baud Rate – 921600/(Divisor + (ENUM/8))) / Target Baud Rate)* 100%

E.g.,

To calculate 500000 bps

Divisor = 1, ENUM = 7,

Inaccuracy = 1.7%

* To work reliably, you should set inaccuracy under 2%.

Special Note

1. If the target baudrate is not a special baudrate (e.g. 50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600), the termios cflag will be set to the same flag.
2. If you use **stty** to get the serial information, you will get speed equal to 0 for the special baudrate.

Digital I/O

Digital Output channels can be set to high or low. The channels are controlled by the function call **set_dout_state( )**. Use the digital input channels to detect the state change of the digital input signal. The DI channels can also be used to detect whether or not the state of a digital signal changes during a fixed period of time. This can be done by the function call, **set_din_event( )**.

Return error code definitions:

```
#define DIO_ERROR_PORT -1 // no such port
#define DIO_ERROR_MODE -2 // no such mode or state
```

```
#define DIO_ERROR_CONTROL -3 // open or ioctl fail
#define DIO_ERROR_DURATION -4 // The value of duration is not 0 or not in the range, 40 <= duration <= 3600000 milliseconds (1 hour)
#define DIO_ERROR_DURATION_20MS -5 // The value of duration must be a multiple of 20 ms
#define DIO_OK 0
```

DIN and DOUT definitions:

```
#define DIO_HIGH 1
#define DIO_LOW 0
```

Moxa functions for DI/DO

Function	**int set_dout_state(int doport, int state)**
Description	Set the DOUT port to high or low state.
Input	<doport> The DOUT port you want to set. Port starts from 0 to 3 <state> Set high or low state; DIO_HIGH (1) for high, DIO_LOW (0) for low.
Output	none
Return	refer to the error code

Function	**int get_din_state(int diport, int *state)**
Description	Get the DIN port state
Input	<diport> The DIN port to get the state of. Port numbering is from 0 to 3 <state> Save the current state
Output	<state> DIO_HIGH (1) for high, DIO_LOW (0) for low
Return	Refer to the error code

Function	**int get_dout_state(int doport, int *state)**
Description	Get the DOUT port state
Input	<doport> The DOUT port to get the state of. <state> Save the current state.
Output	<state> DIO_HIGH (1) for high, DIO_LOW (0) for low
Return	Refer to the error code

Function	**int set_din_event(int diport, void (*func)(int diport), int mode, long int duration)**
Description	Set the DIN event when the state is changed from high to low or from low to high
Input	<diport> The port that will be used to detect the DIN event. Port numbering is from 0 to 3. This value depends on your device. <(*func) (int diport)> Not NULL: Returns the call back function. When the event occurs, the call back

	function will be invoked. NULL: Clear this event <mode> DIN_EVENT_HIGH_TO_LOW (1): From high to low DIN_EVENT_LOW_TO_HIGH (0): From low to high DIN_EVENT_CLEAR (-1): Clear this event <duration> 0: Detect the din event DIN_EVENT_HIGH_TO_LOW or DIN_EVENT_LOW_TO_HIGH without duration Not 0: Detect the din event DIN_EVENT_HIGH_TO_LOW or DIN_EVENT_LOW_TO_HIGH with duration. Note: The value of "duration" must be a multiple of 20 milliseconds. The range of "duration" is 0, or 40 <= duration <= 3600000 milliseconds. The error of the measurement is 24 ms. For example, if the DIN duration is 200 ms, this event will be generated when the DIN pin stays in the same state for a time between 176 ms and 200 ms.
Output	None
Return	Refer to the error code

Function	**int get_din_event(int diport, int *mode, long int *duration)**
Description	To retrieve the DIN event configuration, including mode (DIN_EVENT_HIGH_TO_LOW or DIN_EVENT_LOW_TO_HIGH), and the value of "duration."
Input	<diport> Which DIN port you want to retrieve <mode> Save the set event. <duration> The duration the DIN port is kept in high or low state. - return to the current duration value of diport
Output	<mode> DIN_EVENT_HIGH_TO_LOW (1): From high to low DIN_EVENT_LOW_TO_HIGH(0): From low to high DIN_EVENT_CLEAR(-1): Clear this event <duration> The value of duration should be 0 or 40 <= duration <= 3600000 milliseconds.
Return	Refer to the error code

Special Note

1. You have to build the moxalib in advance for DI/DO. The moxalib is included in the folder **\example\moxalib** in CD.
2. Make sure to link the library **libmoxalib** for DI/DO programming, and include the header file **moxadevice.h**. Only one program at a time can use the DI/DO library.
3. Due to hardware limitation, you need to modify MIN_DURATION as 60 for V2406/2422/2426-LX.

Examples

Example files tdio.c and Makefile are located in the folder \example\tdio\ on the CD.

WDT (Watch Dog Timer)

Introduction

The WDT works like a watchdog function. When a user application enables the software watchdog, it should ack it periodically. Otherwise, if the WDT doesn't get acknowledgement from the application and the timeout expires, it thinks the application crashed and reboots the system.

The timeout could be set in a range of 50 microseconds to 60 seconds.

How the WDT works

The software watchdog is enabled when the system boots up, at which time the kernel will ack it automatically. The user application can enable a user space watchdog with functions since the software watchdog will reboot the system if the user application doesn't ack it and the timeout expires.

Kernel boot

…..

….

User application running and enable user ack

….

….

The user API

Function	int swtd_open(void)
Description	Open the file handle to control the software watchdog.
Input	None
Output	None
Return	On success, return a file handle. Otherwise, return < 0 value.

Function	int swtd_enable(int fd, unsigned long time)
Description	Enable software watchdog. And you must do swtd_ack() after this procedure
Input	<fd> the file handle, from the swtd_open() return value <time> The time you wish to ack software watchdog periodically. Note: You must ack the software watchdog before timeout. Otherwise, the system will reboot automatically. The minimal time is 50 msec, the maximum time is 60 seconds. The time unit is msec.
Output	None
Return	On success, 0 is returned. Otherwise, an error number is return

Function	int swtd_disable(int fd)
Description	Disable the application to ack software watchdog. And the kernel will ack it automatically.
Input	<fd> the file handle from swtd_open() return value.
Output	None
Return	On success, 0 is returned. Otherwise, an error number is return

Function	int swtd_get(int fd, int *mode, unsigned long *time)
Description	Get current setting values.
Input	<fd> the file handle from swtd_open() return value. <*mode> return the status 1(enable) or 0(disable) of userspace watchdog <*time> return the current time period.
Output	None
Return	On success, 0 is returned. Otherwise, an error number is return

Function	int swtd_ack(int fd)
Description	Acknowledge software watchdog. When software watchdog is enabled, application should execute swtd_ack() periodically within user predefined time.
Input	<fd> the file handle from swtd_open() return value.
Output	None
Return	On success, 0 is returned. Otherwise, an error number is return

Function	int swtd_close(int fd)
Description	Close the file handle.
Input	<fd> the file handle from swtd_open() return value.
Output	None
Return	On success, 0 is returned. Otherwise, an error number is return

Special Note

When you "kill the application with -9" or "kill without option" or "Ctrl+c" the kernel will change to auto ack the software watchdog.

When your application enables the software watchdog and does not ack, your application may have a logical error, or your application has made a core dump. The kernel will not change to auto ack. This can cause a serious problem, causing your system to reboot again and again.

Examples

The example file watchdog.c and Makefile are put at \example\swatchdog\ in CD

5

System Recovery

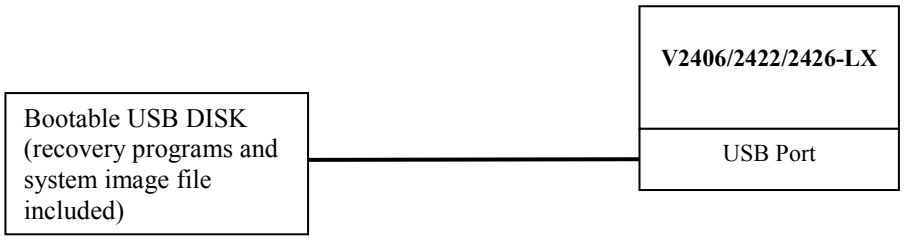
The V2406/2422/2426-LX is installed with the Embedded Linux operating system, which is located in the Flash DOM (CompactFlash card) shipped with the V2406/2422/2426-LX computer. Although it rarely happens, you may find on occasion that operating system files and/or the disk file system are damaged. This chapter describes how to recover the Linux operating system.

This chapter covers the following topics:

- **Recovery Environment**
- **Recovery Procedure**

Recovery Environment

The recovery environment includes the V2101-LX embedded computer and a bootable USB disk with the recovery programs and system image file.



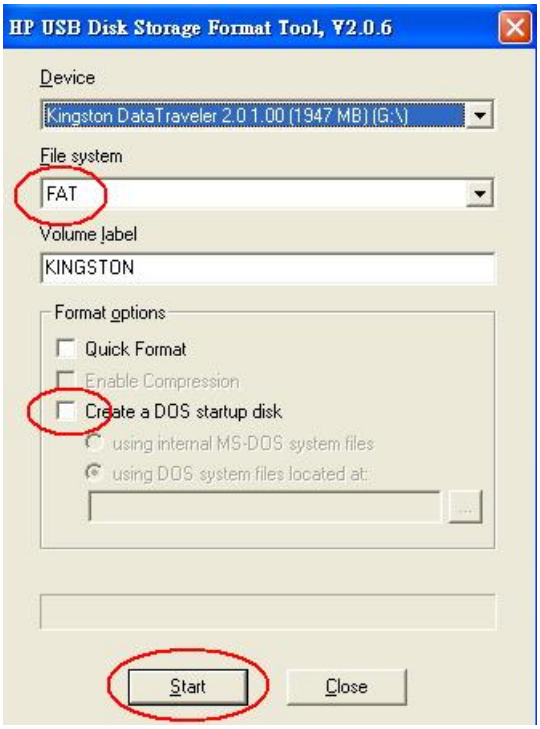
Recovery Procedure

Step 1: Format an Empty USB Disk.

a. Prepare a USB disk that has at least a 256 MB capacity.

b. Format your USB disk with the **HP USB Disk Format Tool**. Open the utility and select the device and FAT file system. You need empty disk only. DO NOT check the option **Create a DOS startup disk**.

c. Click **Start**.



ATTENTION

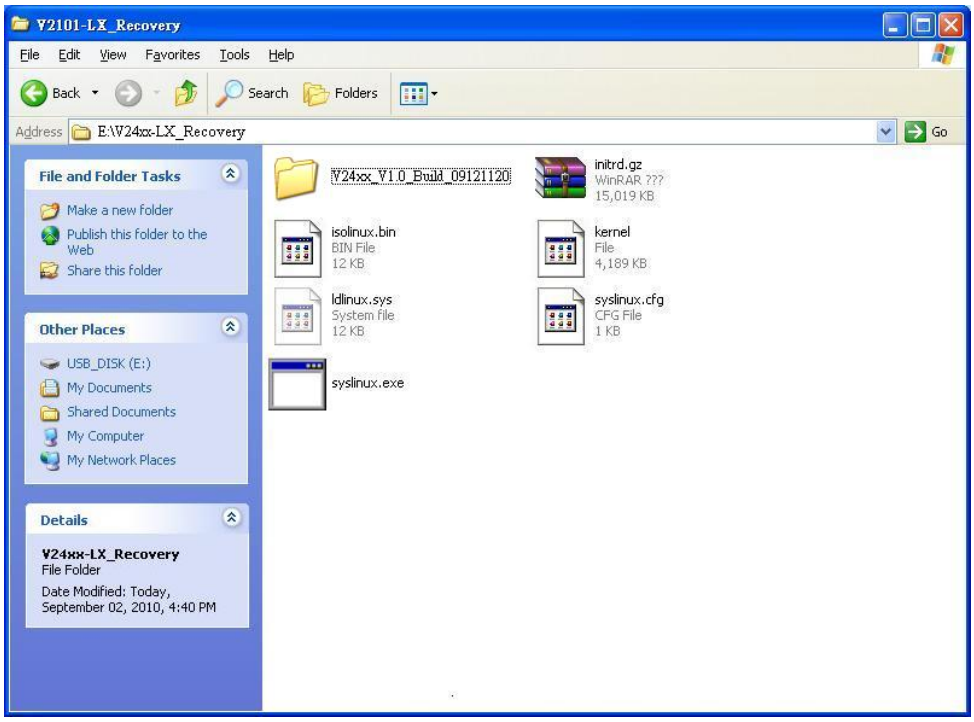
The HP USB Disk Storage Format Tool can be downloaded from many web sites. Do a search on **HP USB Disk Storage Format Tool** from any search engine to locate the tool.

Step 2: Create a Linux Bootable USB Disk.

a. You can find the **firmware** directory in the Recovery CD shipped with the V2406/2422/2426-LX computer.

b. Configure Windows Explorer to show hidden files (including protected operating system files).

c. Copy all files in the **firmware** directory to the root directory of your USB disk.



d. Open a DOS prompt and type **M:\syslinux.exe M:** to create a bootable Linux disk. In this example, M: is the USB Disk drive number.

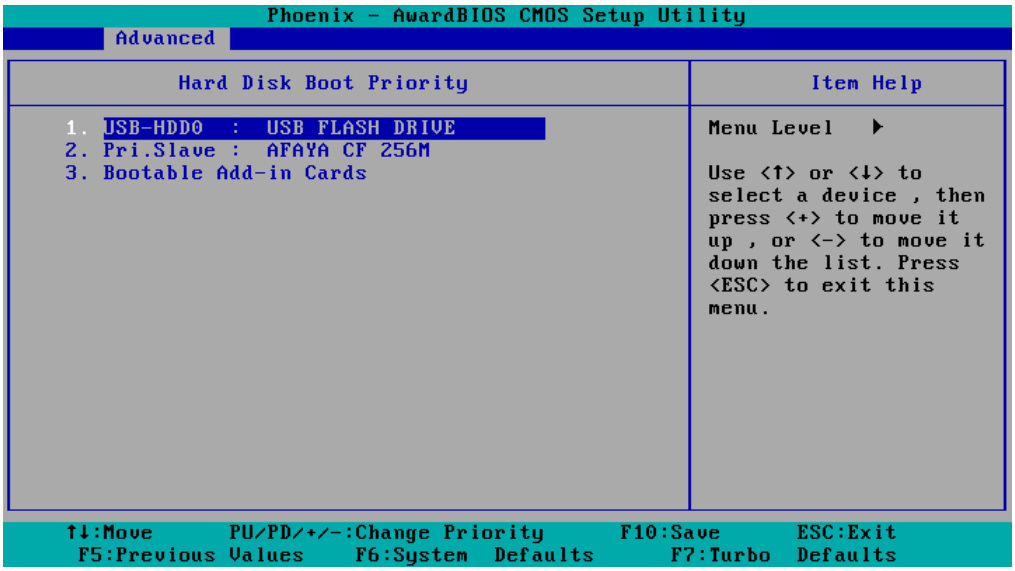
Step 3: Set up the BIOS to Boot from a USB Disk.

a. Insert the USB disk.

b. Power on and press **DEL** to enter the bios setup menu.

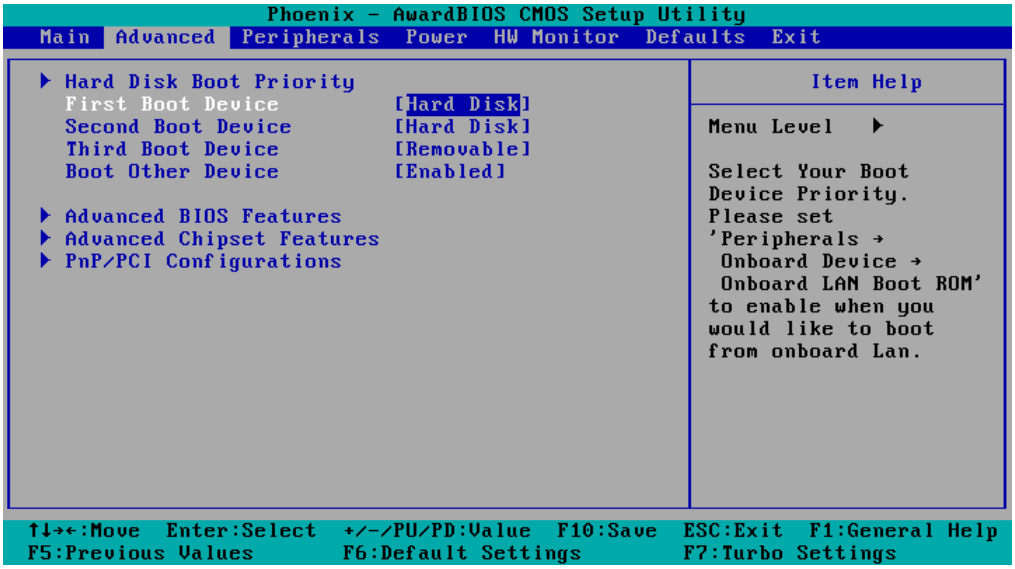
c. Select **Advanced → Hard Disk Boot Priority** and then press **Enter**.

d. From the setup menu, use **"↑"** or **"↓"** to select the USB device


Phoenix - AwardBIOS CMOS Setup Utility
Advanced
Hard Disk Boot Priority
Item Help
1. USB-HDD0 : USB FLASH DRIVE
2. Pri.Slave : AFAYA CF 256M
3. Bootable Add-in Cards
Menu Level ▶
Use <↑> or <↓> to select a device , then press <+> to move it up , or <-> to move it down the list. Press <ESC> to exit this menu.
↑↓:Move PU/PD/+/-:Change Priority F10:Save ESC:Exit
F5:Previous Values F6:System Defaults F7:Turbo Defaults

e. Press "+" to move the selection up to the first priority, and press **Esc** to exit the setup menu.

f. Make sure the first boot device is **Hard Disk**. If not, press **Enter** to change it.


Phoenix - AwardBIOS CMOS Setup Utility
Main Advanced Peripherals Power HW Monitor Defaults Exit
▶ Hard Disk Boot Priority
First Boot Device [Hard Disk]
Second Boot Device [Hard Disk]
Third Boot Device [Removable]
Boot Other Device [Enabled]
▶ Advanced BIOS Features
▶ Advanced Chipset Features
▶ PnP/PCI Configurations
Item Help
Menu Level ▶
Select Your Boot Device Priority. Please set 'Peripherals → Onboard Device → Onboard LAN Boot ROM' to enable when you would like to boot from onboard Lan.
↑↓→←:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Default Settings F7:Turbo Settings

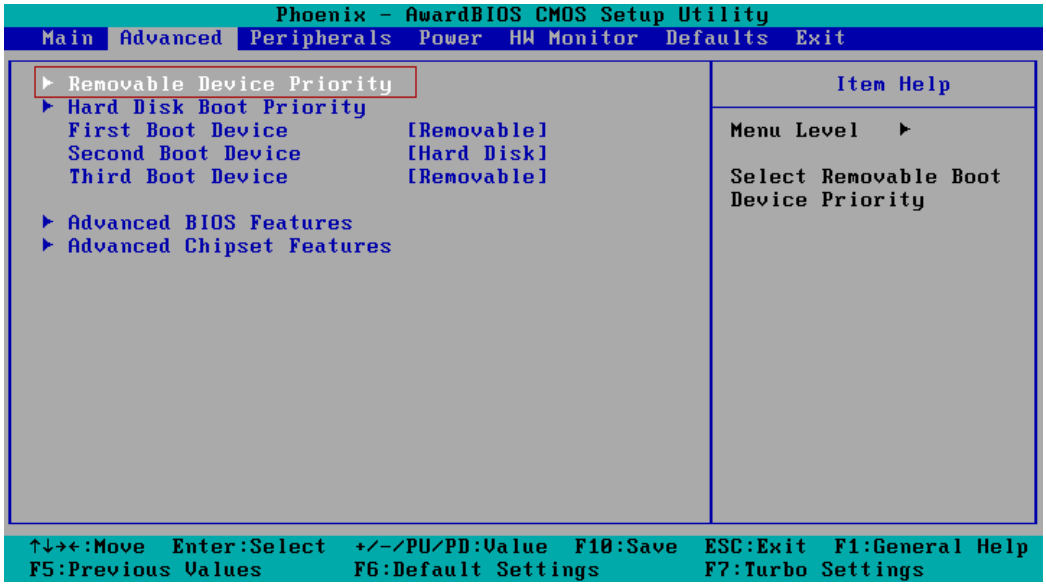
g. Select **Exit → Save & Exit Setup** and then press **Enter**.

h. Choose **Y** to save to the CMOS and then exit.

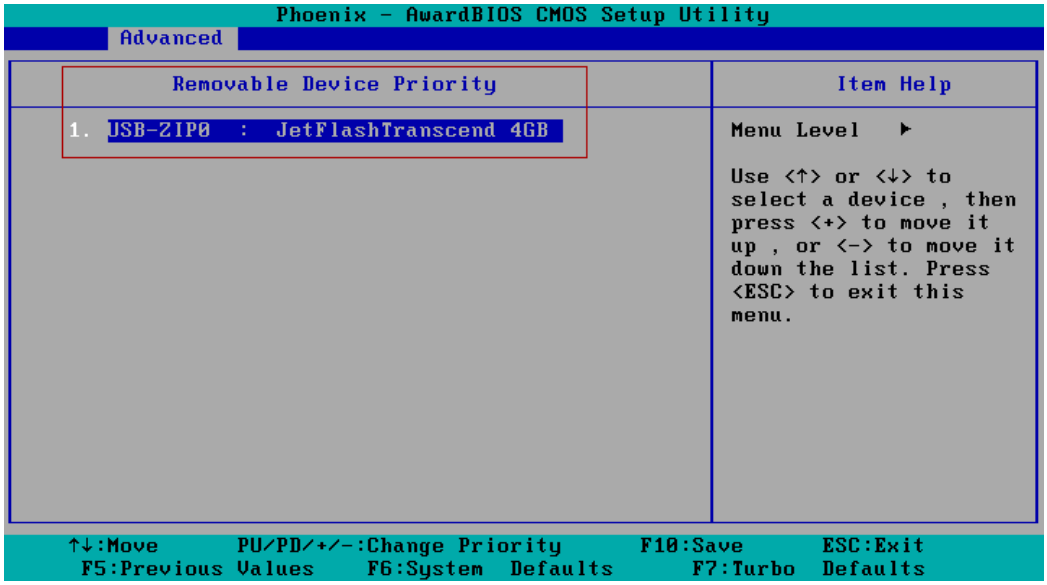
ATTENTION

Please note that some USB disks will be regarded as the **Removable Device**. If it happens, see the following steps.

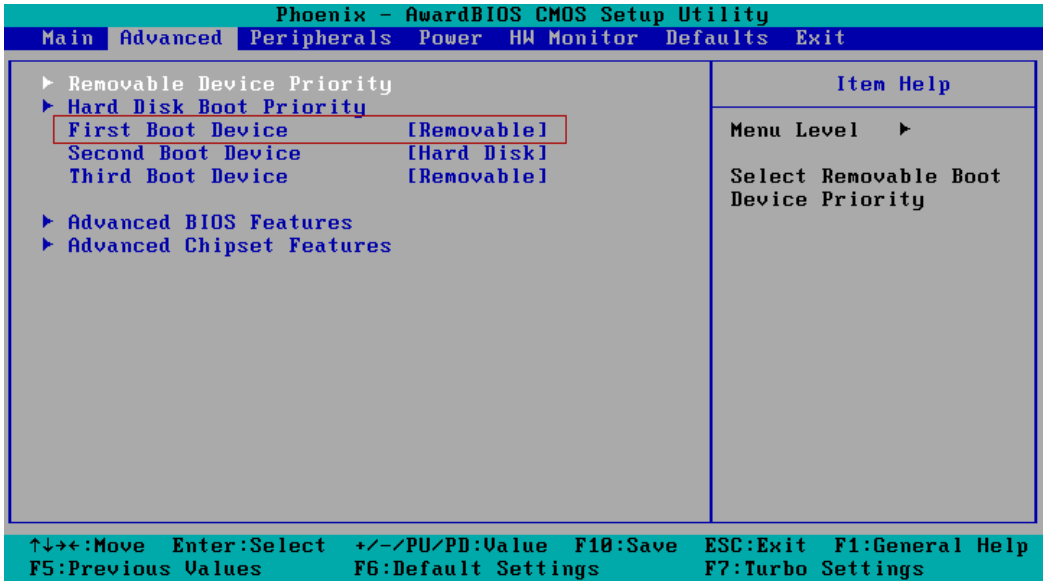
a. Select **Removable Device Priority**.


Phoenix - AwardBIOS CMOS Setup Utility
Main Advanced Peripherals Power HW Monitor Defaults Exit
Removable Device Priority
Hard Disk Boot Priority
First Boot Device [Removable]
Second Boot Device [Hard Disk]
Third Boot Device [Removable]
Advanced BIOS Features
Advanced Chipset Features
Item Help
Menu Level ▶
Select Removable Boot Device Priority
↑↓→←:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Default Settings F7:Turbo Settings

b. Make sure that the USB disk has been detected. Press **Esc** to exit.


Phoenix - AwardBIOS CMOS Setup Utility
Advanced
Removable Device Priority
1. USB-ZIP0 : JetFlashTranscend 4GB
Item Help
Menu Level ▶
Use <↑> or <↓> to select a device , then press <+> to move it up , or <-> to move it down the list. Press <ESC> to exit this menu.
↑↓:Move PU/PD/+/-:Change Priority F10:Save ESC:Exit
F5:Previous Values F6:System Defaults F7:Turbo Defaults

c. Make sure that the **First Boot Device is Removable**. If not, select **First Boot Device**, press **Enter** and select it from the list.

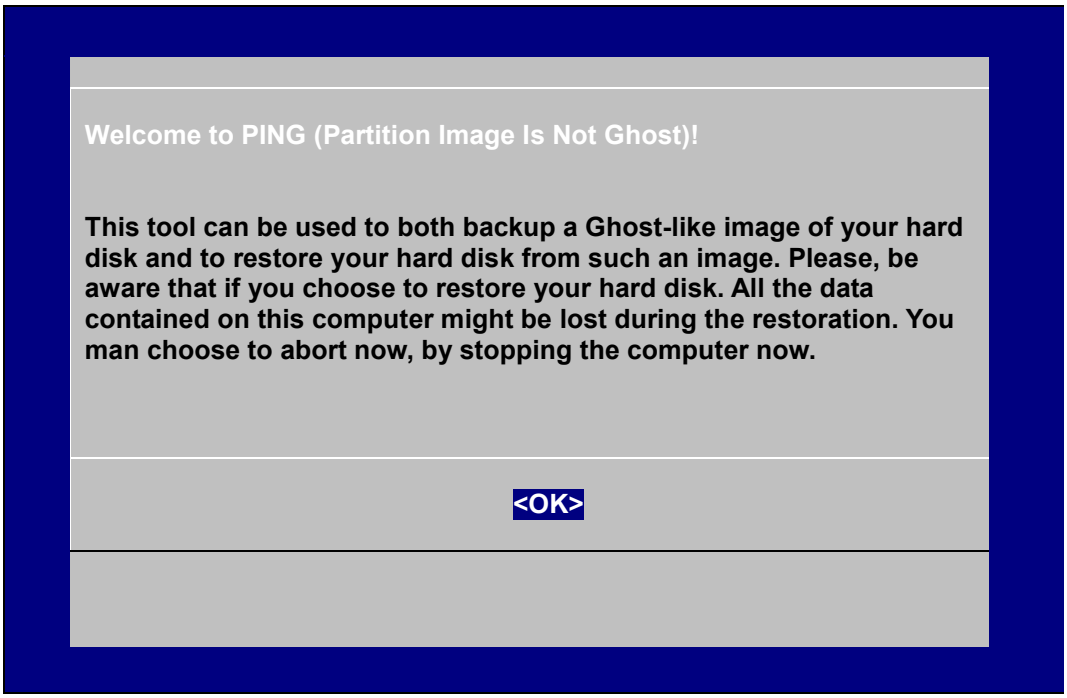

Phoenix - AwardBIOS CMOS Setup Utility
Main Advanced Peripherals Power HW Monitor Defaults Exit
Removable Device Priority
Hard Disk Boot Priority
First Boot Device [Removable]
Second Boot Device [Hard Disk]
Third Boot Device [Removable]
Advanced BIOS Features
Advanced Chipset Features
Item Help
Menu Level
Select Removable Boot Device Priority
↑↓→←:Move Enter:Select +/-/PU/PD:Value F10:Save ESC:Exit F1:General Help
F5:Previous Values F6:Default Settings F7:Turbo Settings

d. Select **Exit → Save & Exit Setup** and then press **Enter**.

e. Choose **Y** to save to the CMOS and then exit.

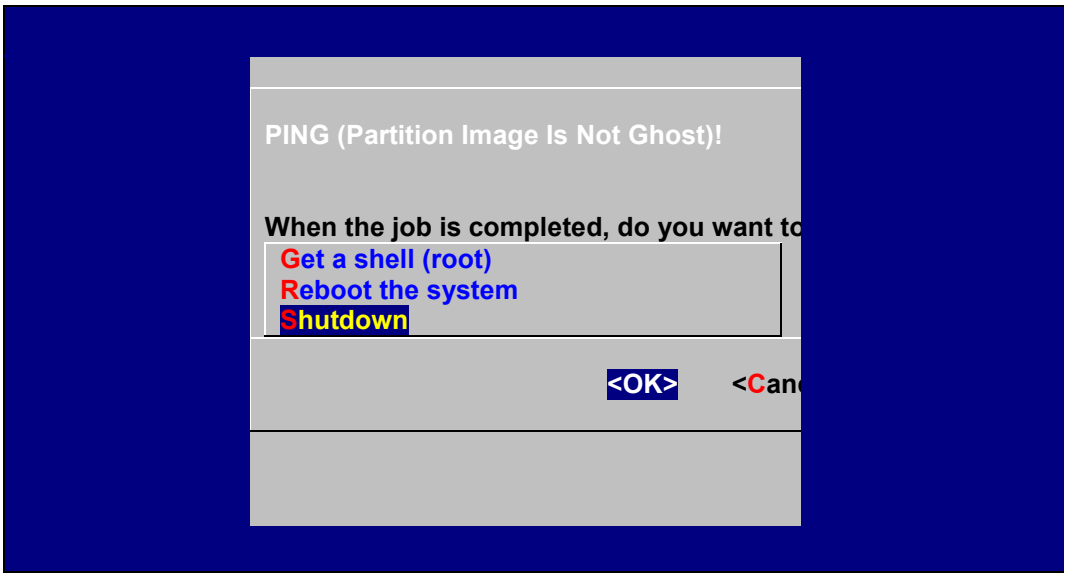
Step 4: Recover the Linux system from a USB Disk.

a. If the BIOS setup is correct, it will boot from the USB disk. Follow the steps below to set up recovery parameters.

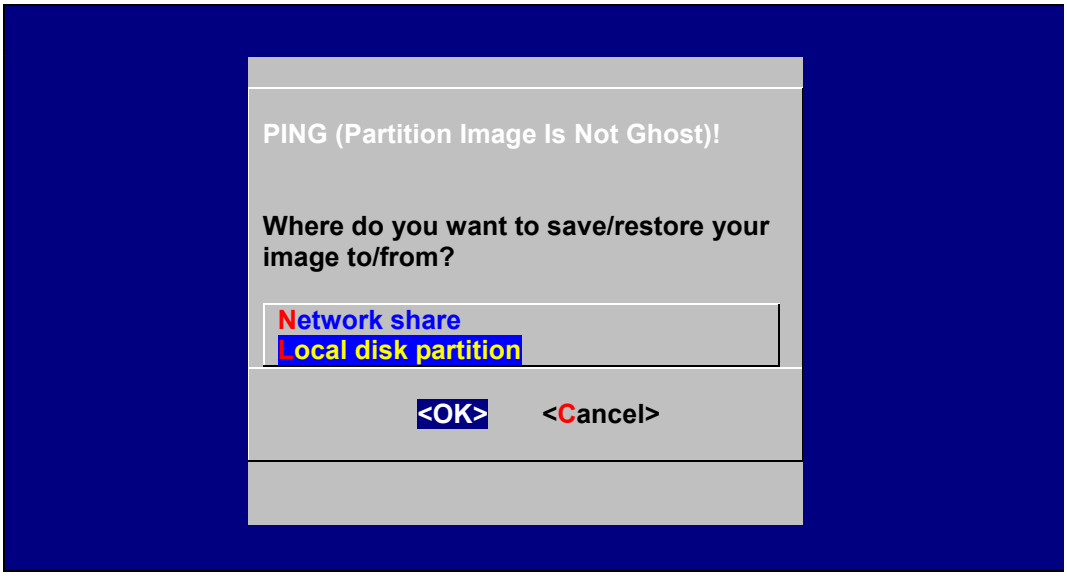

Welcome to PING (Partition Image Is Not Ghost)!
This tool can be used to both backup a Ghost-like image of your hard disk and to restore your hard disk from such an image. Please, be aware that if you choose to restore your hard disk. All the data contained on this computer might be lost during the restoration. You man choose to abort now, by stopping the computer now.
<OK>

b. Choose **OK** to go to the next step.

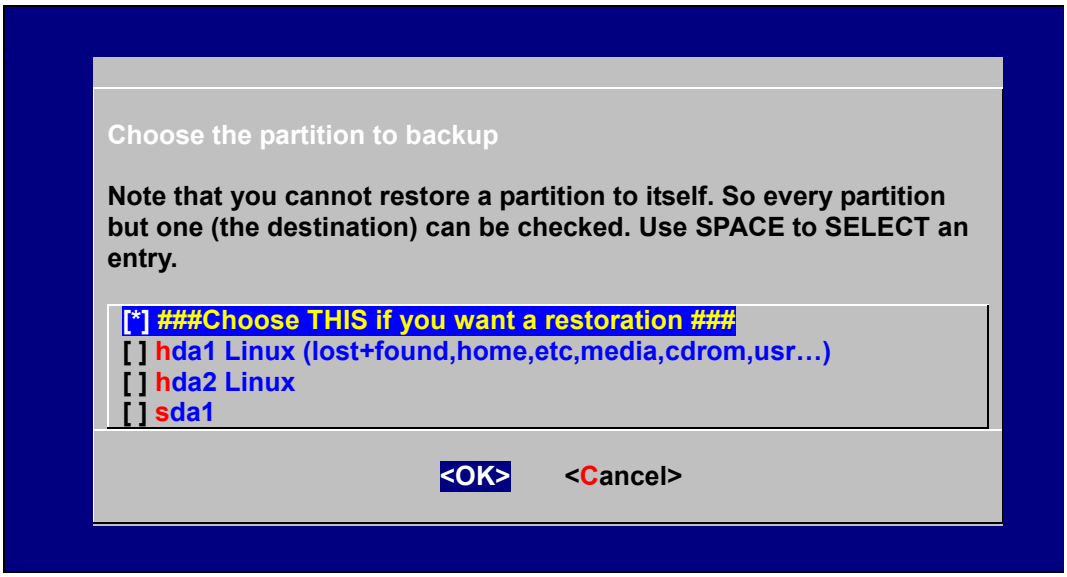
c. Choose shut down the V2101-LX when the restoration is finished.



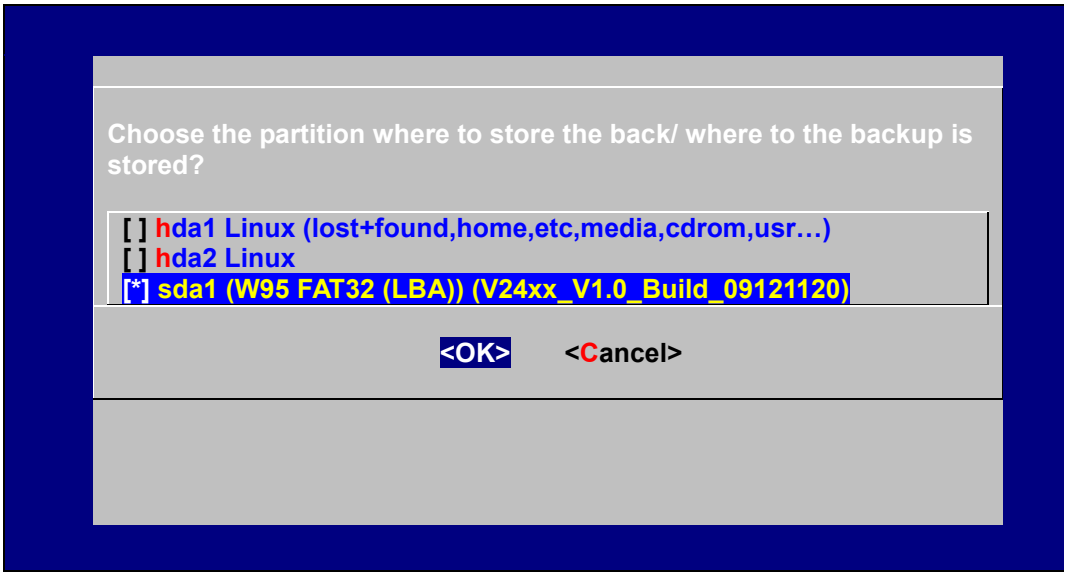
d. Choose restore image from **Local disk partition**.


PING (Partition Image Is Not Ghost)!
Where do you want to save/restore your image to/from?
Network share
Local disk partition
<OK>
<Cancel>

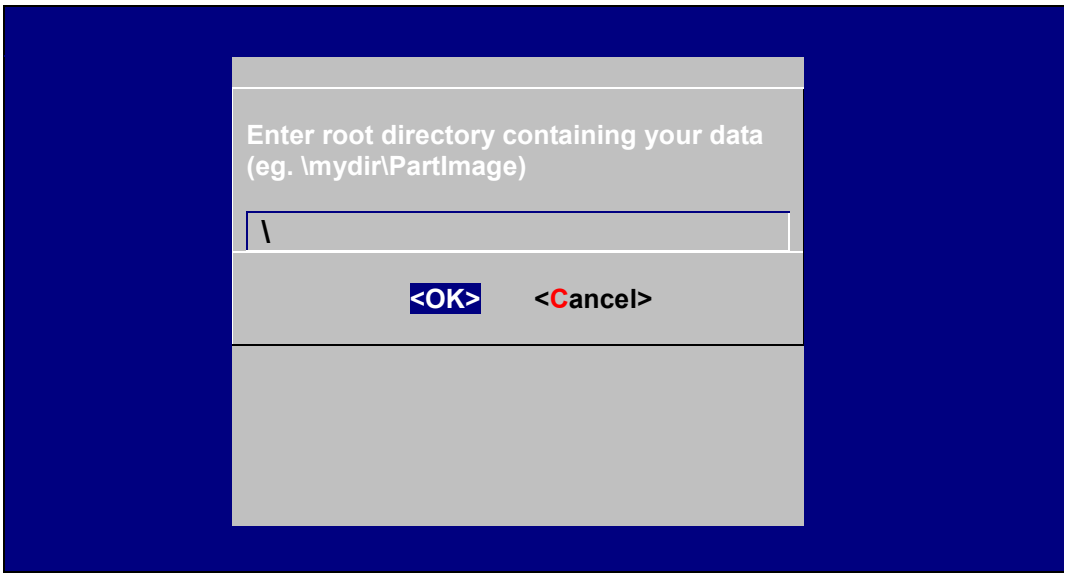
e. Choose ### **Choose THIS if you want a restoration** ###


Choose the partition to backup
Note that you cannot restore a partition to itself. So every partition but one (the destination) can be checked. Use SPACE to SELECT an entry.
[*] ###Choose THIS if you want a restoration ###
[ ] hda1 Linux (lost+found,home,etc,media,cdrom,usr…)
[ ] hda2 Linux
[ ] sda1
<OK>
<Cancel>

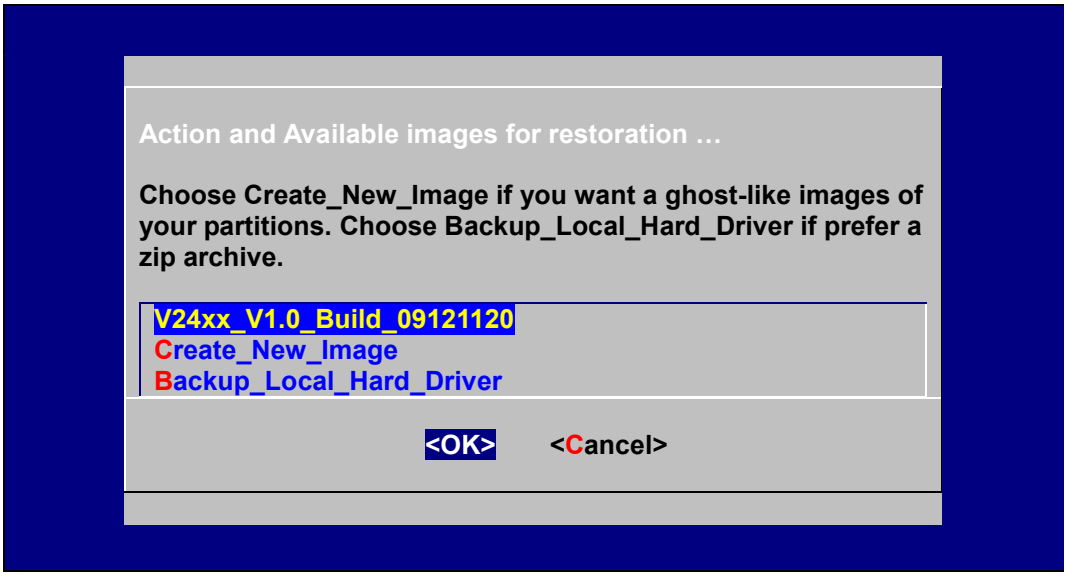
f. Choose the restoration source device **sda1**.


Choose the partition where to store the back/ where to the backup is stored?
[ ] hda1 Linux (lost+found,home,etc,media,cdrom,usr…)
[ ] hda2 Linux
[*] sda1 (W95 FAT32 (LBA)) (V24xx_V1.0_Build_09121120)
<OK>
<Cancel>

g. Enter "\" to choose the root directory of the restoration image.



h. Choose **V24xx_V1.0_Build_09121120** for the restoration image.


Action and Available images for restoration …
Choose Create_New_Image if you want a ghost-like images of your partitions. Choose Backup_Local_Hard_Driver if prefer a zip archive.
V24xx_V1.0_Build_09121120
Create_New_Image
Backup_Local_Hard_Driver
<OK>
<Cancel>

When operation is finished, turn off the computer and remove the USB disk.

ATTENTION

DO NOT turn off the power during system recovery, as the system may crash.

Step 5: Set up the BIOS back to boot from CompactFlash Disk.

a. Power on and press **DEL** to enter the bios setup menu.

b. Select **Advanced → Hard Disk Boot Priority** and then press **Enter**.

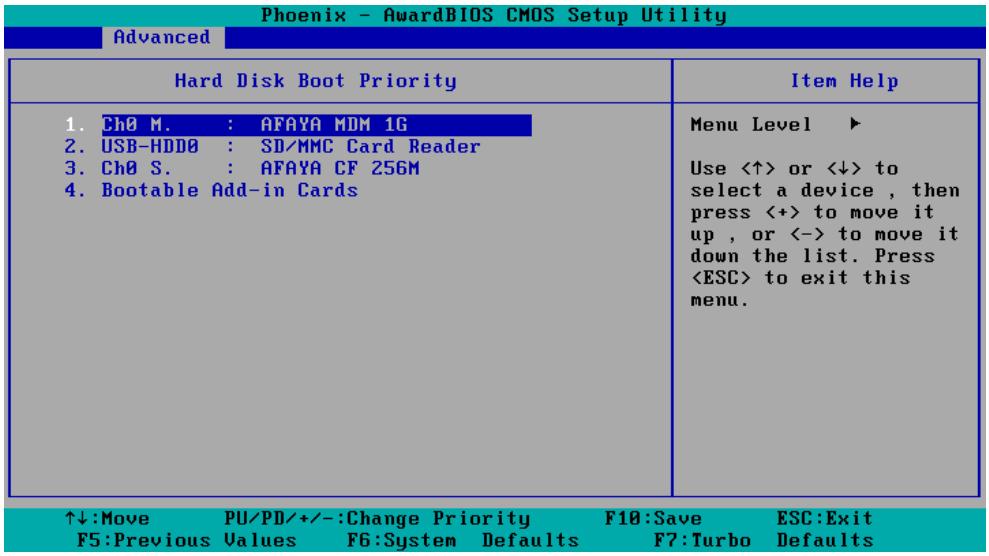
c. From the setup menu, use **"↑"** or **"↓"** to select the DOM or CompactFlash device.

d. Press **"+"** to move the selection up to the first priority, and press **Esc** to exit the setup menu.

e. Select **Exit → Save & Exit Setup** and then press **Enter**.

f. Choose **Y** to save to the CMOS and then exit.

g. Wait a few minutes for the system to boot. When the recovery process is finished, you will again be able to see the Linux desktop.


Phoenix - AwardBIOS CMOS Setup Utility
Advanced
Hard Disk Boot Priority
Item Help
1. Ch0 M. : AFAYA MDM 1G
2. USB-HDD0 : SD/MMC Card Reader
3. Ch0 S. : AFAYA CF 256M
4. Bootable Add-in Cards
Menu Level ▶
Use <↑> or <↓> to select a device , then press <+> to move it up , or <-> to move it down the list. Press <ESC> to exit this menu.
↑↓:Move PU/PD/+/-:Change Priority F10:Save ESC:Exit
F5:Previous Values F6:System Defaults F7:Turbo Defaults

A

Software Components

acpi-support-base	0.109-11	scripts for handling base ACPI events such as the power button
acpid	1.0.8-1lenny2	Utilities for using ACPI power management
adduser	3.110	add and remove users and groups
alacarte	0.11.5-1	easy GNOME menu editing tool
alsa-base	1.0.17.dfsg-4	ALSA driver configuration files
alsa-utils	1.0.16-2	ALSA utilities
apache2	2.2.9-10+lenny6	Apache HTTP Server metapackage
apache2-mpm-prefork	2.2.9-10+lenny6	Apache HTTP Server - traditional non-threaded model
apache2-utils	2.2.9-10+lenny6	utility programs for webservers
apache2.2-common	2.2.9-10+lenny6	Apache HTTP Server common files
app-install-data	2008.11.27	Application Installer Data Files
apt	0.7.20.2+lenny1	Advanced front-end for dpkg
apt-utils	0.7.20.2+lenny1	APT utility programs
aptitude	0.4.11.11-1~lenny1	terminal-based package manager
aspell	0.60.6-1	GNU Aspell spell-checker
aspell-en	6.0-0-5.1	English dictionary for GNU Aspell
autoconf	2.61-8	automatic configure script builder
autoconf2.13	2.13-59	automatic configure script builder (obsolete version)
automake	1:1.10.1-3	A tool for generating GNU Standards-compliant Makefiles
automake1.4	1:1.4-p6-13	A tool for generating GNU Standards-compliant Makefiles
autotools-dev	20080123.1	Update infrastructure for config.{guess,sub} files
base-files	5lenny4	Debian base system miscellaneous files
base-passwd	3.5.20	Debian base system master password and group files
bash	3.2-4	The GNU Bourne Again SHell
bash-completion	20080705	programmable completion for the bash shell
bc	1.06.94-3	The GNU bc arbitrary precision calculator language
bind9-host	1:9.5.1.dfsg.P3-1+lenny1	Version of 'host' bundled with BIND 9.X
binutils	2.18.1~cvs20080103-7	The GNU assembler, linker and binary utilities
bridge-utils	1.4-5	Utilities for configuring the Linux Ethernet

		bridge
bsdmainutils	6.1.10	collection of more utilities from FreeBSD
bsdutils	1:2.13.1.1-1	Basic utilities from 4.4BSD-Lite
busybox	1:1.10.2-2	Tiny utilities for small and embedded systems
bzip2	1.0.5-1	high-quality block-sorting file compressor - utilities
capplets-data	1:2.22.2.1-2	configuration applets for GNOME 2 - data files
cdrdao	1:1.2.2-16	records CDs in Disk-At-Once (DAO) mode
console-common	0.7.80	basic infrastructure for text console configuration
console-data	2:1.07-11	keymaps, fonts, charset maps, fallback tables for console-tool
console-tools	1:0.2.3dbs-65.1	Linux console and font utilities
coreutils	6.10-6	The GNU core utilities
cpio	2.9-13	GNU cpio -- a program to manage archives of files
cpp	4:4.3.2-2	The GNU C preprocessor (cpp)
cpp-4.3	4.3.2-1.1	The GNU C preprocessor
cron	3.0pl1-105	management of regular background processing
dbus	1.2.1-5+lenny1	simple interprocess messaging system
dbus-x11	1.2.1-5+lenny1	simple interprocess messaging system (X11 deps)
debconf	1.5.24	Debian configuration management system
debconf-i18n	1.5.24	full internationalization support for debconf
debian-archive-keyring	2009.01.31	GnuPG archive keys of the Debian archive
debian-faq	4.0.4	The Debian FAQ
debianutils	2.30	Miscellaneous utilities specific to Debian
deborphan	1.7.27	program that can find unused packages, e.g. libraries
defoma	0.11.10-0.2	Debian Font Manager -- automatic font configuration framework
deskbar-applet	2.22.3.1-1	universal search and navigation bar for GNOME
desktop-base	5.0.3	common files for the Debian Desktop
desktop-file-utils	0.15-1	Utilities for .desktop files
dhcp3-client	3.1.1-6+lenny3	DHCP client
dhcp3-common	3.1.1-6+lenny3	common files used by all the dhcp3* packages
dialog	1.1-20080316-1	Displays user-friendly dialog boxes from shell scripts
dictionaries-common	0.98.12	Common utilities for spelling dictionary tools
diff	2.8.1-12	File comparison utilities
dmidecode	2.9-1	Dump Desktop Management Interface data
dnsutils	1:9.5.1.dfsg.P3-1+lenny1	Clients provided with BIND
doc-base	0.8.20	utilities to manage online documentation
docbook-xml	4.5-6	standard XML documentation system, for software and systems

dpkg	1.14.25	Debian package management system
dvd+rw-tools	7.1-3	DVD+-RW/R tools
e2fslibs	1.41.3-1	ext2 filesystem libraries
e2fsprogs	1.41.3-1	ext2/ext3/ext4 file system utilities
eject	2.1.5+deb1-4	ejects CDs and operates CD-Changers under Linux
eog	2.22.3-2	Eye of GNOME graphics viewer program
esound-clients	0.2.36-3	Enlightened Sound Daemon - clients
esound-common	0.2.36-3	Enlightened Sound Daemon - Common files
ethtool	6+20080913-1	display or change Ethernet device settings
evolution-data-server	2.22.3-1.1+lenny2	evolution database backend server
evolution-data-server-common	2.22.3-1.1+lenny2	architecture independent files for Evolution Data Server
fam	2.7.0-13.3+lenny1	File Alteration Monitor
file	4.26-1	Determines file type using "magic" numbers
findutils	4.4.0-2	utilities for finding files--find, xargs
fontconfig	2.6.0-3	generic font configuration library - support binaries
fontconfig-config	2.6.0-3	generic font configuration library - configuration
ftp	0.17-18	The FTP client
g++	4:4.3.2-2	The GNU C++ compiler
g++-4.3	4.3.2-1.1	The GNU C++ compiler
gcc	4:4.3.2-2	The GNU C compiler
gcc-4.2-base	4.2.4-6	The GNU Compiler Collection (base package)
gcc-4.3	4.3.2-1.1	The GNU C compiler
gcc-4.3-base	4.3.2-1.1	The GNU Compiler Collection (base package)
gconf2	2.22.0-1	GNOME configuration database system (support tools)
gconf2-common	2.22.0-1	GNOME configuration database system (common files)
gdb	6.8-3	The GNU Debugger
gdm	2.20.7-4lenny1	GNOME Display Manager
gdm-themes	0.6.1	Themes for the GNOME Display Manager
gedit	2.22.3-1+lenny1	official text editor of the GNOME desktop environment
gedit-common	2.22.3-1+lenny1	official text editor of the GNOME desktop environment (support
genisoimage	9:1.1.9-1	Creates ISO-9660 CD-ROM filesystem images
gettext-base	0.17-4	GNU Internationalization utilities for the base system
gksu	2.0.0-8	graphical frontend to su
gnome-about	2.22.3-2	The GNOME about box
gnome-applets	2.22.3-3	Various applets for GNOME 2 panel - binary files
gnome-applets-data	2.22.3-3	Various applets for GNOME 2 panel - data files
gnome-control-center	1:2.22.2.1-2	utilities to configure the GNOME desktop
gnome-core	1:2.22.2~5	The GNOME Desktop Environment --

		essential components
gnome-desktop-data	2.22.3-2	Common files for GNOME 2 desktop apps
gnome-doc-utils	0.12.2-1	a collection of documentation utilities for the Gnome project
gnome-icon-theme	2.22.0-1	GNOME Desktop icon theme
gnome-keyring	2.22.3-2	GNOME keyring services (daemon and tools)
gnome-media	2.22.0-3	GNOME media utilities
gnome-media-common	2.22.0-3	GNOME media utilities - common files
gnome-menus	2.22.2-4	an implementation of the freedesktop menu specification for GN
gnome-mime-data	2.18.0-1	base MIME and Application database for GNOME.
gnome-mount	0.7-2	wrapper for (un)mounting and ejecting storage devices
gnome-netstatus-applet	2.12.1-2	Network status applet for GNOME 2
gnome-panel	2.20.3-5	launcher and docking facility for GNOME
gnome-panel-data	2.20.3-5	common files for the GNOME Panel
gnome-power-manager	2.22.1-4	power management tool for the GNOME desktop
gnome-session	2.22.3-2	The GNOME 2 Session Manager
gnome-settings-daemon	2.22.2.1-2	GNOME settings daemon
gnome-system-monitor	2.22.3-1	Process viewer and system resource monitor for GNOME 2
gnome-terminal	2.22.3-3	The GNOME 2 terminal emulator application
gnome-terminal-data	2.22.3-3	Data files for the GNOME terminal emulator
gnome-user-guide	2.22.1-1	GNOME user's guide
gnome-utils	2.20.0.1-3	GNOME desktop utilities
gnupg	1.4.9-3+lenny1	GNU privacy guard - a free PGP replacement
gpgv	1.4.9-3+lenny1	GNU privacy guard - signature verification tool
grep	2.5.3~dfsg-6	GNU grep, egrep and fgrep
groff-base	1.18.1.1-21	GNU troff text-formatting system (base system components)
grub	0.97-47lenny2	GRand Unified Bootloader (Legacy version)
grub-common	1.96+20080724-16	GRand Unified Bootloader, version 2 (common files)
gstreamer0.10-alsa	0.10.19-2	GStreamer plugin for ALSA
gstreamer0.10-plugins-base	0.10.19-2	GStreamer plugins from the "base" set
gstreamer0.10-plugins-good	0.10.8-4.1~lenny2	GStreamer plugins from the "good" set
gstreamer0.10-x	0.10.19-2	GStreamer plugins for X11 and Pango
gzip	1.3.12-6	The GNU compression utility
hal	0.5.11-8	Hardware Abstraction Layer
hal-info	20080508+git20080601-1	Hardware Abstraction Layer - fdi files
hicolor-icon-theme	0.10-1	default fallback theme for FreeDesktop.org icon themes

hostname	2.95	utility to set/show the host name or domain name
ifenslave	2	Attach and detach slave interfaces to a bonding device
ifenslave-2.6	1.1.0-10	Attach and detach slave interfaces to a bonding device
ifupdown	0.6.8+nmu1	high level tools to configure network interfaces
initramfs-tools	0.92o	tools for generating an initramfs
initscripts	2.86.ds1-61	Scripts for initializing and shutting down the system
iproute	20080725-2	networking and traffic control tools
iptables	1.4.2-6	administration tools for packet filtering and NAT
iputils-ping	3:20071127-1	Tools to test the reachability of network hosts
iso-codes	3.5.1-1	ISO language, territory, currency, script codes and their tran
klibc-utils	1.5.12-2	small utilities built with klibc for early boot
libaa1	1.4p5-37+b1	ascii art library
libacl1	2.2.47-2	Access control list shared library
libao2	0.8.8-4	Cross Platform Audio Output Library
libapache2-mod-php5	5.2.6.dfsg.1-1+lenny4	server-side, HTML-embedded scripting language (Apache 2 module
libapm1	3.2.2-12	Library for interacting with APM driver in kernel
libapr1	1.2.12-5+lenny1	The Apache Portable Runtime Library
libaprutil1	1.2.12+dfsg-8+lenny4	The Apache Portable Runtime Utility Library
libart-2.0-2	2.3.20-2	Library of functions for 2D graphics - runtime files
libasound2	1.0.16-2	ALSA library
libaspell15	0.60.6-1	GNU Aspell spell-checker runtime library
libatk1.0-0	1.22.0-1	The ATK accessibility toolkit
libatk1.0-data	1.22.0-1	Common files for the ATK accessibility toolkit
libattr1	1:2.4.43-2	Extended attribute shared library
libaudiofile0	0.2.6-7+lenny1	Open-source version of SGI's audiofile library
libavahi-client3	0.6.23-3lenny1	Avahi client library
libavahi-common-data	0.6.23-3lenny1	Avahi common data files
libavahi-common3	0.6.23-3lenny1	Avahi common library
libavahi-glib1	0.6.23-3lenny1	Avahi glib integration library
libavc1394-0	0.5.3-1+b1	control IEEE 1394 audio/video devices
libbeagle1	0.3.5-1+b1	library for accessing beagle using C
libbind9-40	1:9.5.1.dfsg.P3-1+lenny1	BIND9 Shared Library used by BIND
libblkid1	1.41.3-1	block device id library
libbonobo2-0	2.22.0-1	Bonobo CORBA interfaces library
libbonobo2-common	2.22.0-1	Bonobo CORBA interfaces library -- support files
libbonoboui2-0	2.22.0-1	The Bonobo UI library

libbonoboui2-common	2.22.0-1	The Bonobo UI library -- common files
libbz2-1.0	1.0.5-1	high-quality block-sorting file compressor library - runtime
libc6	2.7-18lenny2	GNU C Library: Shared libraries
libc6-dev	2.7-18lenny2	GNU C Library: Development Libraries and Header Files
libc6-i686	2.7-18lenny2	GNU C Library: Shared libraries [i686 optimized]
libcaca0	0.99.beta14-1	colour ASCII art library
libcairo-perl	1.060-1	Perl interface to the Cairo graphics library
libcairo2	1.6.4-7	The Cairo 2D vector graphics library
libcairomm-1.0-1	1.6.0-1	C++ wrappers for Cairo (shared libraries)
libcamel1.2-11	2.22.3-1.1+lenny2	The Evolution MIME message handling library
libcap1	1:1.10-14	support for getting/setting POSIX.1e capabilities
libcap2	2.11-2	support for getting/setting POSIX.1e capabilities
libcdio7	0.78.2+dfsg1-3	library to read and control CD-ROM
libcdparanoia0	3.10.2+debian-5	audio extraction tool for sampling CDs (library)
libcomerr2	1.41.3-1	common error description library
libcompress-raw-zlib-perl	2.012-1lenny1	low-level interface to zlib compression library
libcompress-zlib-perl	2.012-1	Perl module for creation and manipulation of gzip files
libconsole	1:0.2.3dbs-65.1	Shared libraries for Linux console and font manipulation
libcpufreq0	004-2	shared library to deal with the cpufreq Linux kernel feature
libcroco3	0.6.1-2	a generic Cascading Style Sheet (CSS) parsing and manipulation
libcucul0	0.99.beta14-1	low-level Unicode character drawing library
libcups2	1.3.8-1+lenny8	Common UNIX Printing System(tm) - libs
libcwidget3	0.5.12-4	high-level terminal interface library for C++ (runtime files)
libdatrie0	0.1.3-2	Double-array trie library
libdb4.5	4.5.20-13	Berkeley v4.5 Database Libraries [runtime]
libdb4.6	4.6.21-11	Berkeley v4.6 Database Libraries [runtime]
libdbus-1-3	1.2.1-5+lenny1	simple interprocess messaging system
libdbus-glib-1-2	0.76-1	simple interprocess messaging system (GLib-based shared librar
libdevmapper1.02.1	2:1.02.27-4	The Linux Kernel Device Mapper userspace library
libdirectfb-1.0-0	1.0.1-11	direct frame buffer graphics - shared libraries
libdirectfb-extra	1.0.1-11	direct frame buffer graphics - extra providers
libdmx1	1:1.0.2-3	X11 Distributed Multihead extension library
libdns45	1:9.5.1.dfsg.P3-1+lenny1	DNS Shared Library used by BIND
libdrm2	2.3.1-2	Userspace interface to kernel DRM services -- runtime

libdv4	1.0.0-1+b1	software library for DV format digital video (runtime lib)
libebook1.2-9	2.22.3-1.1+lenny2	Client library for evolution address books
libecal1.2-7	2.22.3-1.1+lenny2	Client library for evolution calendars
libedata-book1.2-2	2.22.3-1.1+lenny2	Backend library for evolution address books
libedata-cal1.2-6	2.22.3-1.1+lenny2	Backend library for evolution calendars
libedataserver1.2-9	2.22.3-1.1+lenny2	Utility library for evolution data servers
libedataserverui1.2-8	2.22.3-1.1+lenny2	GUI utility library for evolution data servers
libedit2	2.11~20080614-1	BSD editline and history libraries
libeel2-2.20	2.20.0-7	Eazel Extensions Library (for GNOME2)
libeel2-data	2.20.0-7	Eazel Extensions Library - data files (for GNOME2)
libegroupwise1.2-13	2.22.3-1.1+lenny2	Client library for accessing groupwise POA through SOAP interf
libenchant1c2a	1.4.2-3.3	a wrapper library for various spell checker engines
libept0	0.5.22	High-level library for managing Debian package information
libesd0	0.2.36-3	Enlightened Sound Daemon - Shared libraries
libevent1	1.3e-3	An asynchronous event notification library
libexempi3	2.0.1-1	library to parse XMP metadata (Library)
libexif12	0.6.16-2.1	library to parse EXIF files
libexpat1	2.0.1-4+lenny3	XML parsing C library - runtime library
libfam0	2.7.0-13.3+lenny1	Client library to control the FAM daemon
libffi5	3.0.7-1	Foreign Function Interface library runtime
libflac8	1.2.1-1.2	Free Lossless Audio Codec - runtime C library
libfont-afm-perl	1.20-1	Font::AFM - Interface to Adobe Font Metrics files
libfontconfig1	2.6.0-3	generic font configuration library - runtime
libfontenc1	1:1.0.4-3	X11 font encoding library
libfreetype6	2.3.7-2+lenny1	FreeType 2 font engine, shared library files
libfreezethaw-perl	0.43-4	converting Perl structures to strings and back
libfs6	2:1.0.1-1	X11 Font Services library
libgail-common	1.22.3-1	GNOME Accessibility Implementation Library -- common modules
libgail18	1.22.3-1	GNOME Accessibility Implementation Library -- shared libraries
libgc1c2	1:6.8-1.1	conservative garbage collector for C and C++
libgcc1	1:4.3.2-1.1	GCC support library
libgconf2-4	2.22.0-1	GNOME configuration database system (shared libraries)
libgcrypt11	1.4.1-1	LGPL Crypto library - runtime library
libgdata-google1.2-1	2.22.3-1.1+lenny2	Client library for accessing Google POA through SOAP interface
libgdata1.2-1	2.22.3-1.1+lenny2	Client library for accessing Google POA through SOAP interface
libgdbm3	1.8.3-3	GNU dbm database routines (runtime version)
libgksu2-0	2.0.7-1	library providing su and sudo functionality

libgl1-mesa-dri	7.0.3-7	A free implementation of the OpenGL API -- DRI modules
libgl1-mesa-glx	7.0.3-7	A free implementation of the OpenGL API -- GLX runtime
libglade2-0	1:2.6.2-1	library to load .glade files at runtime
libglib-perl	1:1.190-2	Perl interface to the GLib and GObject libraries
libglib2.0-0	2.16.6-3	The GLib library of C routines
libglib2.0-data	2.16.6-3	Common files for GLib library
libglibmm-2.4-1c2a	2.16.4-1	C++ wrapper for the GLib toolkit (shared libraries)
libglu1-mesa	7.0.3-7	The OpenGL utility library (GLU)
libgmp3c2	2:4.2.2+dfsg-3	Multiprecision arithmetic library
libgnome-desktop-2	2.22.3-2	Utility library for loading .desktop files - runtime files
libgnome-keyring0	2.22.3-2	GNOME keyring services library
libgnome-media0	2.22.0-3	runtime libraries for the GNOME media utilities
libgnome-menu2	2.22.2-4	an implementation of the freedesktop menu specification for GN
libgnome-window-settings1	1:2.22.2.1-2	Utility library for getting window manager settings
libgnome2-0	2.20.1.1-1	The GNOME 2 library - runtime files
libgnome2-canvas-perl	1.002-1+b2	Perl interface to the GNOME canvas library
libgnome2-common	2.20.1.1-1	The GNOME 2 library - common files
libgnome2-perl	1.042-1+b1	Perl interface to the GNOME libraries
libgnome2-vfs-perl	1.080-1+b1	Perl interface to the 2.x series of the GNOME VFS library
libgnomecanvas2-0	2.20.1.1-1	A powerful object-oriented display - runtime files
libgnomecanvas2-common	2.20.1.1-1	A powerful object-oriented display - common files
libgnomecups1.0-1	0.2.3-3	GNOME library for CUPS interaction
libgnomekbd-common	2.22.0-1	GNOME library to manage keyboard configuration - common files
libgnomekbd2	2.22.0-1	GNOME library to manage keyboard configuration - shared librar
libgnomekbdui2	2.22.0-1	User interface library for libgnomekbd - shared library
libgnomeprint2.2-0	2.18.5-1	The GNOME 2.2 print architecture - runtime files
libgnomeprint2.2-data	2.18.5-1	The GNOME 2.2 print architecture - data files
libgnomeprintui2.2-0	2.18.3-1	GNOME 2.2 print architecture User Interface - runtime files
libgnomeprintui2.2-common	2.18.3-1	GNOME 2.2 print architecture User Interface - common files
libgnomeui-0	2.20.1.1-2	The GNOME 2 libraries (User Interface) - runtime files
libgnomeui-common	2.20.1.1-2	The GNOME 2 libraries (User Interface) - common files
libgnomevfs2-0	1:2.22.0-5	GNOME Virtual File System (runtime

		libraries)
libgnomevfs2-bin	1:2.22.0-5	GNOME Virtual File System (support binaries)
libgnomevfs2-common	1:2.22.0-5	GNOME Virtual File System (common files)
libgnomevfs2-extra	1:2.22.0-5	GNOME Virtual File System (extra modules)
libgnutls26	2.4.2-6+lenny2	the GNU TLS library - runtime library
libgomp1	4.3.2-1.1	GCC OpenMP (GOMP) support library
libgpg-error0	1.4-2	library for common error values and messages in GnuPG componen
libgpm2	1.20.4-3.1	General Purpose Mouse - shared library
libgsf-1-114	1.14.8-1lenny2	Structured File Library - runtime version
libgsf-1-common	1.14.8-1lenny2	Structured File Library - common files
libgssglue1	0.1-2	mechanism-switch gssapi library
libgstreamer-plugins-base0.10-0	0.10.19-2	GStreamer libraries from the "base" set
libgstreamer0.10-0	0.10.19-3	Core GStreamer libraries and elements
libgtk2-perl	1:1.190-1	Perl interface to the 2.x series of the Gimp Toolkit library
libgtk2.0-0	2.12.12-1~lenny1	The GTK+ graphical user interface library
libgtk2.0-bin	2.12.12-1~lenny1	The programs for the GTK+ graphical user interface library
libgtk2.0-common	2.12.12-1~lenny1	Common files for the GTK+ graphical user interface library
libgtkmm-2.4-1c2a	1:2.12.7-1	C++ wrappers for GTK+ 2.4 (shared libraries)
libgtksourceview-common	1.8.5-1	common files for the GTK+ syntax highlighting widget
libgtksourceview1.0-0	1.8.5-1	shared libraries for the GTK+ syntax highlighting widget
libgtksourceview2.0-0	2.2.2-1	shared libraries for the GTK+ syntax highlighting widget
libgtksourceview2.0-common	2.2.2-1	common files for the GTK+ syntax highlighting widget
libgtop2-7	2.22.3-1	gtop system monitoring library
libgtop2-common	2.22.3-1	common files for the gtop system monitoring library
libgucharmap6	1:2.22.3-2	Unicode browser widget library (shared library)
libgweather-common	2.22.3-1	GWeather common files
libgweather1	2.22.3-1	GWeather shared library
libhal-storage1	0.5.11-8	Hardware Abstraction Layer - shared library for storage device
libhal1	0.5.11-8	Hardware Abstraction Layer - shared library
libhtml-format-perl	2.04-2	format HTML syntax trees into text, PostScript or RTF
libhtml-parser-perl	3.56-1+lenny1	A collection of modules that parse HTML text documents
libhtml-tagset-perl	3.20-2	Data tables pertaining to HTML
libhtml-tree-perl	3.23-1	represent and create HTML syntax trees
libhunspell-1.2-0	1.2.6-1	spell checker and morphological analyzer (shared library)

libice6	2:1.0.4-1	X11 Inter-Client Exchange library
libidl0	0.8.10-0.1	library for parsing CORBA IDL files
libidn11	1.8+20080606-1	GNU libidn library, implementation of IETF IDN specifications
libiec61883-0	1.1.0-2	an partial implementation of IEC 61883
libio-compress-base-perl	2.012-1	Base Class for IO::Compress modules
libio-compress-zlib-perl	2.012-1	Perl interface to zlib
libisc45	1:9.5.1.dfsg.P3-1+lenny1	ISC Shared Library used by BIND
libisccc40	1:9.5.1.dfsg.P3-1+lenny1	Command Channel Library used by BIND
libisccfg40	1:9.5.1.dfsg.P3-1+lenny1	Config File Handling Library used by BIND
libjpeg62	6b-14	The Independent JPEG Group's JPEG runtime library
libkeyutils1	1.2-9	Linux Key Management Utilities (library)
libklibc	1.5.12-2	minimal libc subset for use with initramfs
libkrb53	1.6.dfsg.4~beta1-5lenny1	MIT Kerberos runtime libraries
liblcms1	1.17.dfsg-1+lenny2	Color management library
libldap-2.4-2	2.4.11-1+lenny1	OpenLDAP libraries
liblocale-gettext-perl	1.05-4	Using libc functions for internationalization in Perl
liblockfile1	1.08-3	NFS-safe locking library, includes dotlockfile program
liblwres40	1:9.5.1.dfsg.P3-1+lenny1	Lightweight Resolver Library used by BIND
liblzo2-2	2.03-1	data compression library
libmagic1	4.26-1	File type determination library using "magic" numbers
libmailtools-perl	2.03-1	Manipulate email in perl programs
libmalaga7	7.12-1	An automatic language analysis library
libmetacity0	1:2.22.0-2	library of lightweight GTK2 based Window Manager
libmldbm-perl	2.01-2	Store multidimensional hash structures in perl tied hashes
libmozjs1d	1.9.0.19-1	The Mozilla SpiderMonkey JavaScript library
libmpfr1ldbl	2.3.1.dfsg.1-2	multiple precision floating-point computation
libmysqlclient15off	5.0.51a-24+lenny2	MySQL database client library
libnautilus-burn4	2.20.0-1	Nautilus Burn Library - runtime version
libnautilus-extension1	2.20.0-7	libraries for nautilus components - runtime version
libncurses5	5.7+20081213-1	shared libraries for terminal handling
libncursesw5	5.7+20081213-1	shared libraries for terminal handling (wide character support
libnet-dbus-perl	0.33.6-1+b1	Extension for the DBus bindings
libnet-lite-ftp-perl	0.54-2	Perl FTP client with support for TLS
libnet-ssleay-perl	1.35-1	Perl module for Secure Sockets Layer (SSL)

libnet-telnet-perl	3.03-3	Script telnetable connections
libnewt0.52	0.52.2-11.3+lenny1	Not Erik's Windowing Toolkit - text mode windowing with slang
libnfsidmap2	0.20-1	An nfs idmapping library
libnotify1	0.4.4-3	sends desktop notifications to a notification daemon
libnspr4-0d	4.7.1-5	NetScape Portable Runtime Library
libnss3-1d	3.12.3.1-0lenny1	Network Security Service libraries
libogg0	1.1.3-4	Ogg Bitstream Library
liboil0.3	0.3.15-1	Library of Optimized Inner Loops
liboobs-1-4	2.22.0-2	GObject based interface to system-tools-backends - shared libr
liborbit2	1:2.14.13-0.1	libraries for ORBit2 - a CORBA ORB
libpam-gnome-keyring	2.22.3-2	PAM module to unlock the GNOME keyring upon login
libpam-modules	1.0.1-5+lenny1	Pluggable Authentication Modules for PAM
libpam-runtime	1.0.1-5+lenny1	Runtime support for the PAM library
libpam0g	1.0.1-5+lenny1	Pluggable Authentication Modules library
libpanel-applet2-0	2.20.3-5	library for GNOME Panel applets
libpango1.0-0	1.20.5-5+lenny1	Layout and rendering of internationalized text
libpango1.0-common	1.20.5-5+lenny1	Modules and configuration files for the Pango
libpcap0.8	0.9.8-5	system interface for user-level packet capture
libpci3	1:3.0.0-6	Linux PCI Utilities (shared library)
libpcre3	7.6-2.1	Perl 5 Compatible Regular Expression Library - runtime files
libperl5.10	5.10.0-19lenny2	Shared Perl library
libpixman-1-0	0.10.0-2	pixel-manipulation library for X and cairo
libpkcs11-helper1	1.05-1	library that simplifies the interaction with PKCS#11
libpng12-0	1.2.27-2+lenny3	PNG library - runtime
libpopt0	1.14-4	lib for parsing cmdline parameters
libpq5	8.3.9-0lenny1	PostgreSQL C client library
librarian0	0.8.1-1	Rarian is a documentation meta-data library (library package)
libraw1394-8	1.3.0-4	library for direct access to IEEE 1394 bus (aka FireWire)
libreadline5	5.2-3.1	GNU readline and history libraries, run-time libraries
librpcsecgss3	0.18-1	allows secure rpc communication using the rpcsec_gss protocol
librsvg2-2	2.22.2-2lenny1	SAX-based renderer library for SVG files (runtime)
librsvg2-common	2.22.2-2lenny1	SAX-based renderer library for SVG files (extra runtime)
libsasl2-2	2.1.22.dfsg1-23+lenny1	Cyrus SASL - authentication abstraction library
libscrollkeeper0	0.3.14-16	Library to load .omf files (runtime files)
libselinux1	2.0.65-5	SELinux shared libraries
libsensors3	1:2.10.7-1	library to read temperature/voltage/fan

		sensors
libsepol1	2.0.30-2	Security Enhanced Linux policy library for changing policy bin
libsexy2	0.1.11-2+b1	collection of additional GTK+ widgets - library
libshout3	2.2.2-5	MP3/Ogg Vorbis broadcast streaming library
libsigc++-2.0-0c2a	2.0.18-2	type-safe Signal Framework for C++ - runtime
libslab0	0.9.8.svn.20070430-1.1	beautification app library file
libslang2	2.1.3-3	The S-Lang programming library - runtime version
libsm6	2:1.0.3-2	X11 Session Management library
libsmbclient	2:3.2.5-4lenny12	shared library that allows applications to talk to SMB/CIFS se
libsmbios-bin	2.0.3.dfsg-1	Provide access to (SM)BIOS information -- utility binaries
libsmbios2	2.0.3.dfsg-1	Provide access to (SM)BIOS information -- dynamic library
libsnmp-base	5.4.1~dfsg-12	SNMP (Simple Network Management Protocol) MIBs and documentati
libsnmp15	5.4.1~dfsg-12	SNMP (Simple Network Management Protocol) library
libsoup2.4-1	2.4.1-2	an HTTP library implementation in C -- Shared library
libspeex1	1.2~rc1-1	The Speex codec runtime library
libsplashy1	0.3.13-3	Library to draw splash screen on boot, shutdown, resume or sus
libsqlite3-0	3.5.9-6	SQLite 3 shared library
libss2	1.41.3-1	command-line interface parsing library
libssl0.9.8	0.9.8g-15+lenny5	SSL shared libraries
libstartup-notification0	0.9-1	library for program launch feedback (shared library)
libstdc++6	4.3.2-1.1	The GNU Standard C++ Library v3
libstdc++6-4.3-dev	4.3.2-1.1	The GNU Standard C++ Library v3 (development files)
libsysfs2	2.1.0-5	interface library to sysfs
libtag1c2a	1.5-3	TagLib Audio Meta-Data Library
libtalloc1	1.2.0~git20080616-1	hierarchical pool based memory allocator
libtasn1-3	1.4-1	Manage ASN.1 structures (runtime)
libtext-charwidth-perl	0.04-5+b1	get display widths of characters on the terminal
libtext-iconv-perl	1.7-1+b1	converts between character sets in Perl
libtext-wrapi18n-perl	0.06-6	internationalized substitute of Text::Wrap
libthai-data	0.1.9-4+lenny1	Data files for Thai language support library
libthai0	0.1.9-4+lenny1	Thai language support library
libtheora0	1.0~beta3-1+lenny1	The Theora Video Compression Codec
libtie-ixhash-perl	1.21-2	ordered associative arrays for Perl
libtiff4	3.8.2-11.2	Tag Image File Format (TIFF) library
libtimedate-perl	1.1600-9	Time and date functions for Perl
libtotem-plparser10	2.22.3-1	Totem Playlist Parser library - runtime version

libtrackerclient0	0.6.6-2	metadata database, indexer and search tool - library
libts-0.0-0	1.0-4	touch screen library
liburi-perl	1.35.dfsg.1-1	Manipulates and accesses URI strings
libusb-0.1-4	2:0.1.12-13	userspace USB programming library
libuuid-perl	0.02-3+b1	Perl extension for using UUID interfaces as defined in e2fspro
libuuid1	1.41.3-1	universally unique id library
libvisual-0.4-0	0.4.0-2.1	Audio visualization framework
libvisual-0.4-plugins	0.4.0.dfsg.1-2	Audio visualization framework plugins
libvoikko1	1.7-2	Finnish spell-checker and hyphenator library
libvolume-id0	0.125-7+lenny3	libvolume_id shared library
libvorbis0a	1.2.0.dfsg-3.1+lenny1	The Vorbis General Audio Compression Codec
libvorbisenc2	1.2.0.dfsg-3.1+lenny1	The Vorbis General Audio Compression Codec
libvorbisfile3	1.2.0.dfsg-3.1+lenny1	The Vorbis General Audio Compression Codec
libvte-common	1:0.16.14-4	Terminal emulator widget for GTK+ 2.0 - common files
libvte9	1:0.16.14-4	Terminal emulator widget for GTK+ 2.0 - runtime files
libwavpack1	4.50.1-1	an audio codec (lossy and lossless) - library
libwbclient0	2:3.2.5-4lenny12	client library for interfacing with winbind service
libwnck-common	2.22.3-1	Window Navigator Construction Kit - common files
libwnck22	2.22.3-1	Window Navigator Construction Kit - runtime files
libwrap0	7.6.q-16	Wietse Venema's TCP wrappers library
libwww-perl	5.813-1	WWW client/server library for Perl (aka LWP)
libx11-6	2:1.1.5-2	X11 client-side library
libx11-data	2:1.1.5-2	X11 client-side library
libx86-1	1.1+ds1-2	x86 real-mode library
libxapian15	1.0.7-4	Search engine library
libxau6	1:1.0.3-3	X11 authorisation library
libxaw7	2:1.0.4-2	X11 Athena Widget library
libxcb-render-util0	0.2.1+git1-1	utility libraries for X C Binding -- render-util
libxcb-render0	1.1-1.2	X C Binding, render extension
libxcb-xlib0	1.1-1.2	X C Binding, Xlib/XCB interface library
libxcb1	1.1-1.2	X C Binding
libxcomposite1	1:0.4.0-3	X11 Composite extension library
libxcursor1	1:1.1.9-1	X cursor management library
libxdamage1	1:1.1.1-4	X11 damaged region extension library
libxdmcp6	1:1.0.2-3	X11 Display Manager Control Protocol library
libxext6	2:1.0.4-1	X11 miscellaneous extension library
libxfixes3	1:4.0.3-2	X11 miscellaneous 'fixes' extension library
libxfont1	1:1.3.3-1	X11 font rasterisation library
libxft2	2.1.12-3	FreeType-based font drawing library for X
libxi6	2:1.1.4-1	X11 Input extension library

libxinerama1	2:1.0.3-2	X11 Xinerama extension library
libxkbfile1	1:1.0.5-1	X11 keyboard file manipulation library
libxklavier12	3.5-2	X Keyboard Extension high-level API
libxml-parser-perl	2.36-1.1+b1	Perl module for parsing XML files
libxml-twig-perl	1:3.32-1	Perl module for processing huge XML documents in tree mode
libxml-xpath-perl	1.13-6	Perl module for processing XPath
libxml2	2.6.32.dfsg-5+lenny1	GNOME XML library
libxml2-utils	2.6.32.dfsg-5+lenny1	XML utilities
libxmu6	2:1.0.4-1	X11 miscellaneous utility library
libxmuu1	2:1.0.4-1	X11 miscellaneous micro-utility library
libxpm4	1:3.5.7-1	X11 pixmap library
libxrandr2	2:1.2.3-1	X11 RandR extension library
libxrender1	1:0.9.4-2	X Rendering Extension client library
libxres1	2:1.0.3-1	X11 Resource extension library
libxslt1.1	1.1.24-2	XSLT processing library - runtime library
libxss1	1:1.1.3-1	X11 Screen Saver extension library
libxt6	1:1.0.5-3	X11 toolkit intrinsics library
libxtrap6	2:1.0.0-5	X11 event trapping extension library
libxtst6	2:1.0.3-1	X11 Testing -- Resource extension library
libxv1	2:1.0.4-1	X11 Video extension library
libxxf86dga1	2:1.0.2-1	X11 Direct Graphics Access extension library
libxxf86misc1	1:1.0.1-3	X11 XFree86 miscellaneous extension library
libxxf86vm1	1:1.0.2-1	X11 XFree86 video mode extension library
linux-image-2.6-686	2.6.26+17+lenny1	Linux 2.6 image on PPro/Celeron/PII/PIII/P4
linux-image-2.6.26-2-686	2.6.26-19lenny2	Linux 2.6.26 image on PPro/Celeron/PII/PIII/P4
linux-image-2.6.30-bpo.2-686	2.6.30-8~bpo50+2	Linux 2.6.30 image on PPro/Celeron/PII/PIII/P4
linux-libc-dev	2.6.26-19lenny2	Linux support headers for userspace development
linux-sound-base	1.0.17.dfsg-4	base package for ALSA and OSS sound systems
locales	2.7-18	GNU C Library: National Language (locale) data [support]
lockfile-progs	0.1.11-0.1	Programs for locking and unlocking files and mailboxes
login	1:4.1.1-6	system login tools
logrotate	3.7.1-5	Log rotation utility
lrzsz	0.12.21-4.1	Tools for zmodem/xmodem/ymodem file transfer
lsb-base	3.2-20	Linux Standard Base 3.2 init script functionality
lsof	4.78.dfsg.1-4	List open files
lzma	4.43-14	Compression method of 7z format in 7-Zip program
m4	1.4.11-1	a macro processing language

make	3.81-5	The GNU version of the "make" utility.
makedev	2.3.1-88	creates device files in /dev
man-db	2.5.2-4	on-line manual pager
manpages	3.05-1	Manual pages about using a GNU/Linux system
mawk	1.3.3-11.1	a pattern scanning and text processing language
menu	2.1.41	generates programs menu for all menu-aware applications
menu-xdg	0.3	freedesktop.org menu compliant window manager scripts
metacity	1:2.22.0-2	A lightweight GTK2 based Window Manager
metacity-common	1:2.22.0-2	Shared files of lightweight GTK2 based Window Manager
mime-support	3.44-1	MIME files 'mime.types' & 'mailcap', and support programs
minicom	2.3-1	friendly menu driven serial communication program
mktemp	1.5-9	tool for creating temporary files
mlocate	0.21.1-1	quickly find files on the filesystem based on their name
modconf	0.3.9	Device Driver Configuration
module-init-tools	3.4-1	tools for managing Linux kernel modules
mount	2.13.1.1-1	Tools for mounting and manipulating filesystems
mutt	1.5.18-6	text-based mailreader supporting MIME, GPG, PGP and threading
myspell-en-us	1:2.4.0-3	English_american dictionary for myspell
mysql-common	5.0.51a-24+lenny2	MySQL database common files
nautilus	2.20.0-7	file manager and graphical shell for GNOME
nautilus-cd-burner	2.20.0-1	CD Burning front-end for Nautilus
nautilus-data	2.20.0-7	data files for nautilus
ncurses-base	5.7+20081213-1	basic terminal type definitions
ncurses-bin	5.7+20081213-1	terminal-related programs and man pages
ncurses-term	5.7+20081213-1	additional terminal type definitions
net-tools	1.60-22	The NET-3 networking toolkit
netbase	4.34	Basic TCP/IP networking system
netcat-traditional	1.10-38	TCP/IP swiss army knife
nfs-common	1:1.1.2-6lenny1	NFS support files common to client and server
notification-daemon	0.3.7-1+b1	a daemon that displays passive pop-up notifications
ntpdate	1:4.2.4p4+dfsg-8lenny3	client for setting system time from NTP servers
openbsd-inetd	0.20080125-2	The OpenBSD Internet Superserver
openssh-blacklist	0.4.1	list of default blacklisted OpenSSH RSA and DSA keys
openssh-blacklist-extra	0.4.1	list of non-default blacklisted OpenSSH RSA and DSA keys
openssh-client	1:5.1p1-5	secure shell client, an rlogin/rsh/rcp

		replacement
openssh-server	1:5.1p1-5	secure shell server, an rshd replacement
openssl	0.9.8g-15+lenny6	Secure Socket Layer (SSL) binary and related cryptographic too
openssl-blacklist	0.4.2	list of blacklisted OpenSSL RSA keys
openvpn	2.1~rc11-1	virtual private network daemon
openvpn-blacklist	0.3	list of blacklisted OpenVPN RSA shared keys
oss-compat	0.0.4+nmu2	OSS compatibility package
passwd	1:4.1.1-6	change and administer password and group data
pciutils	1:3.0.0-6	Linux PCI Utilities
perl	5.10.0-19lenny2	Larry Wall's Practical Extraction and Report Language
perl-base	5.10.0-19lenny2	minimal Perl system
perl-modules	5.10.0-19lenny2	Core Perl modules
php5-common	5.2.6.dfsg.1-1+lenny4	Common files for packages built from the php5 source
pm-utils	1.1.2.4-1	utilities and scripts for power management
portmap	6.0-9	RPC port mapper
powermgmt-base	1.30+nmu1	Common utils and configs for power management
ppp	2.4.4rel-10.1	Point-to-Point Protocol (PPP) - daemon
pppconfig	2.3.18	A text menu based utility for configuring ppp
pppoe	3.8-3	PPP over Ethernet driver
pppoeconf	1.18	configures PPPoE/ADSL connections
procps	1:3.2.7-11	/proc file system utilities
proftpd	1.3.1-17lenny4	versatile, virtual-hosting FTP daemon
proftpd-basic	1.3.1-17lenny4	versatile, virtual-hosting FTP daemon - binaries
proftpd-mod-ldap	1.3.1-17lenny4	versatile, virtual-hosting FTP daemon - LDAP module
proftpd-mod-mysql	1.3.1-17lenny4	versatile, virtual-hosting FTP daemon - MySQL module
proftpd-mod-pgsql	1.3.1-17lenny4	versatile, virtual-hosting FTP daemon - PostgreSQL module
psmisc	22.6-1	Utilities that use the proc filesystem
python	2.5.2-3	An interactive high-level object-oriented language (default ve
python-beagle	0.3.5-1+b1	Python bindings for beagle
python-cairo	1.4.12-1.2	Python bindings for the Cairo vector graphics library
python-central	0.6.8	register and build utility for Python packages
python-dbus	0.82.4-2	simple interprocess messaging system (Python interface)
python-fpconst	0.7.2-4	Utilities for handling IEEE 754 floating point special values
python-glade2	2.12.1-6	GTK+ bindings: Glade support
python-gmenu	2.22.2-4	an implementation of the freedesktop menu specification for GN
python-gnome2	2.22.0-1	Python bindings for the GNOME desktop

		environment
python-gnome2-desktop	2.22.0-2	Python bindings for the GNOME desktop environment
python-gobject	2.14.2-2	Python bindings for the GObject library
python-gtk2	2.12.1-6	Python bindings for the GTK+ widget set
python-gtksourceview2	2.2.0-1+b1	Python bindings for the GtkSourceView widget
python-libxml2	2.6.32.dfsg-5+lenny1	Python bindings for the GNOME XML library
python-minimal	2.5.2-3	A minimal subset of the Python language (default version)
python-numeric	24.2-9	Numerical (matrix-oriented) Mathematics for Python
python-pyorbit	2.14.3-2	A Python language binding for the ORBit2 CORBA implementation
python-soappy	0.12.0-4	SOAP Support for Python
python-support	0.8.4lenny1	automated rebuilding support for Python modules
python2.5	2.5.2-15	An interactive high-level object-oriented language (version 2.
python2.5-minimal	2.5.2-15	A minimal subset of the Python language (version 2.5)
radeontool	1.5-5	utility to control ATI Radeon backlight functions on laptops
readline-common	5.2-3.1	GNU readline and history libraries, common files
rsyslog	3.18.6-4	enhanced multi-threaded syslogd
scrollkeeper	0.3.14-16	A free electronic cataloging system for documentation
sed	4.1.5-6	The GNU sed stream editor
sgml-base	1.26	SGML infrastructure and SGML catalog file support
sgml-data	2.0.3	common SGML and XML data
shared-mime-info	0.30-2	FreeDesktop.org shared MIME database and spec
snmp	5.4.1~dfsg-12	SNMP (Simple Network Management Protocol) applications
snmpd	5.4.1~dfsg-12	SNMP (Simple Network Management Protocol) agents
ssh	1:5.1p1-5	secure shell client and server (metapackage)
ssl-cert	1.0.23	simple debconf wrapper for OpenSSL
sudo	1.6.9p17-3	Provide limited super user privileges to specific users
synaptic	0.62.1+nmu1	Graphical package manager
system-tools-backends	2.6.0-2lenny4	System Tools to manage computer configuration -- scripts
sysv-rc	2.86.ds1-61	System-V-like runlevel change mechanism
sysvinit	2.86.ds1-61	System-V-like init utilities
sysvinit-utils	2.86.ds1-61	System-V-like utilities
tar	1.20-1	GNU version of the tar archiving utility
tasksel	2.78	Tool for selecting tasks for installation on Debian systems

tasksel-data	2.78	Official tasks used for installation of Debian systems
tcpd	7.6.q-16	Wietse Venema's TCP wrapper utilities
tcpdump	3.9.8-4	A powerful tool for network monitoring and data acquisition
telnet	0.17-36	The telnet client
telnetd	0.17-36	The telnet server
tftpd	0.17-16	Trivial file transfer protocol server
time	1.7-23	The GNU time program for measuring cpu resource usage
traceroute	2.0.11-2	Traces the route taken by packets over an IPv4/IPv6 network
ttf-dejavu	2.25-3	Metapackage to pull in ttf-dejavu-core and ttf-dejavu-extra
ttf-dejavu-core	2.25-3	Vera font family derivate with additional characters
ttf-dejavu-extra	2.25-3	Vera font family derivate with additional characters
tzdata	2009l-0lenny1.1	time zone and daylight-saving time data
ucf	3.0016	Update Configuration File: preserve user changes to config fil
udev	0.125-7+lenny3	/dev/ and hotplug management daemon
update-inetd	4.31	inetd configuration file updater
usbmount	0.0.14.1	automatically mount and unmount USB mass storage devices
usbutils	0.73-10	Linux USB utilities
uswsusp	0.7-1.2	tools to use userspace software suspend provided by Linux
util-linux	2.13.1.1-1	Miscellaneous system utilities
vbetool	1.0-3	run real-mode video BIOS code to alter hardware state
vim	1:7.1.314-3+lenny2	Vi IMproved - enhanced vi editor
vim-common	1:7.1.314-3+lenny2	Vi IMproved - Common files
vim-runtime	1:7.1.314-3+lenny2	Vi IMproved - Runtime files
vim-tiny	1:7.1.314-3+lenny2	Vi IMproved - enhanced vi editor - compact version
w3m	0.5.2-2+b1	WWW browsable pager with excellent tables/frames support
watchdog	5.4-10	A software watchdog
wget	1.11.4-2+lenny1	retrieves files from the web
whiptail	0.52.2-11.3+lenny1	Displays user-friendly dialog boxes from shell scripts
whois	4.7.30	an intelligent whois client
wodim	9:1.1.9-1	command line CD/DVD writing tool
x-ttcidfont-conf	31	TrueType and CID fonts configuration for X
x11-apps	7.3+4	X applications
x11-common	1:7.3+20	X Window System (X.Org) infrastructure
x11-session-utils	7.3+1	X session utilities
x11-utils	7.3+2+nmu1	X11 utilities
x11-xfs-utils	7.3+1	X font server utilities
x11-xkb-utils	7.4+1	X11 XKB utilities
x11-xserver-utils	7.3+5	X server utilities

xauth	1:1.0.3-2	X authentication utility
xbase-clients	1:7.3+20	miscellaneous X clients - metapackage
xfonts-100dpi	1:1.0.0-4	100 dpi fonts for X
xfonts-75dpi	1:1.0.0-4	75 dpi fonts for X
xfonts-base	1:1.0.0-5	standard fonts for X
xfonts-encodings	1:1.0.2-3	Encodings for X.Org fonts
xfonts-scalable	1:1.0.0-6	scalable fonts for X
xfonts-utils	1:7.4+1	X Window System font utility programs
xinit	1.0.9-2	X server initialisation tool
xkb-data	1.3-2	X Keyboard Extension (XKB) configuration data
xml-core	0.12	XML infrastructure and XML catalog file support
xorg	1:7.3+20	X.Org X Window System
xorg-docs	1:1.4-4	Miscellaneous documentation for the X.Org software suite
xserver-xephyr	2:1.4.2-10.lenny2	nested X server
xserver-xorg	1:7.3+20	the X.Org X server
xserver-xorg-core	2:1.4.2-10.lenny2	Xorg X server - core server
xserver-xorg-input-all	1:7.3+20	the X.Org X server -- input driver metapackage
xserver-xorg-input-evdev	1:2.0.8-1	X.Org X server -- evdev input driver
xserver-xorg-input-kbd	1:1.3.1-1	X.Org X server -- keyboard input driver
xserver-xorg-input-mouse	1:1.3.0-1	X.Org X server -- mouse input driver
xserver-xorg-input-synaptics	0.14.7~git20070706-3	Synaptics TouchPad driver for X.Org/XFree86 server
xserver-xorg-input-wacom	0.7.9.3-2	X.Org X server -- Wacom input driver
xserver-xorg-video-all	1:7.3+20	the X.Org X server -- output driver metapackage
xserver-xorg-video-apm	1:1.2.0-1	X.Org X server -- APM display driver
xserver-xorg-video-ark	1:0.7.0-1	X.Org X server -- ark display driver
xserver-xorg-video-ati	1:6.9.0-1+lenny4	X.Org X server -- ATI display driver wrapper
xserver-xorg-video-chips	1:1.2.0-1	X.Org X server -- Chips display driver
xserver-xorg-video-cirrus	1:1.2.1-1.lenny1	X.Org X server -- Cirrus display driver
xserver-xorg-video-cyrix	1:1.1.0-8	X.Org X server -- Cyrix display driver
xserver-xorg-video-dummy	1:0.3.0-1	X.Org X server -- dummy display driver
xserver-xorg-video-fbdev	1:0.4.0-1	X.Org X server -- fbdev display driver
xserver-xorg-video-glint	1:1.2.1-1	X.Org X server -- Glint display driver
xserver-xorg-video-i128	1:1.3.0-1	X.Org X server -- i128 display driver
xserver-xorg-video-	1:1.2.0-1	X.Org X server -- i740 display driver

i740		
xserver-xorg-video-imstt	1:1.1.0-7	X.Org X server -- IMSTT display driver
xserver-xorg-video-intel	2:2.3.2-2+lenny6	X.Org X server -- Intel i8xx, i9xx display driver
xserver-xorg-video-mach64	6.8.0-1	X.Org X server -- ATI Mach64 display driver
xserver-xorg-video-mga	1:1.4.9.dfsg-1	X.Org X server -- MGA display driver
xserver-xorg-video-neomagic	1:1.2.1-1	X.Org X server -- Neomagic display driver
xserver-xorg-video-nsc	1:2.8.3-4	X.Org X server -- NSC Geode GX1 display driver
xserver-xorg-video-nv	1:2.1.10-1	X.Org X server -- NV display driver
xserver-xorg-video-openchrome	1:0.2.902+svn579-4	X.Org X server -- VIA display driver
xserver-xorg-video-r128	6.8.0-1	X.Org X server -- ATI r128 display driver
xserver-xorg-video-radeon	1:6.9.0-1+lenny4	X.Org X server -- ATI Radeon display driver
xserver-xorg-video-radeonhd	1.2.1-2	X.Org X server -- AMD/ATI r5xx, r6xx display driver
xserver-xorg-video-rendition	1:4.2.0.dfsg.1-2	X.Org X server -- Rendition display driver
xserver-xorg-video-s3	1:0.6.0-1	X.Org X server -- legacy S3 display driver
xserver-xorg-video-s3virge	1:1.10.1-1	X.Org X server -- S3 ViRGE display driver
xserver-xorg-video-savage	1:2.2.1-2.lenny1	X.Org X server -- Savage display driver
xserver-xorg-video-siliconmotion	1:1.6.0-1	X.Org X server -- SiliconMotion display driver
xserver-xorg-video-sis	1:0.10.0-1	X.Org X server -- SiS display driver
xserver-xorg-video-sisusb	1:0.9.0-1	X.Org X server -- SiS USB display driver
xserver-xorg-video-tdfx	1:1.4.0-1	X.Org X server -- tdfx display driver
xserver-xorg-video-tga	1:1.1.0-9	X.Org X server -- TGA display driver
xserver-xorg-video-trident	1:1.3.0-1	X.Org X server -- Trident display driver
xserver-xorg-video-tseng	1:1.2.0-1	X.Org X server -- Tseng display driver
xserver-xorg-video-v4l	0.2.0-1	X.Org X server -- Video 4 Linux display driver
xserver-xorg-video-vesa	1:1.3.0-4	X.Org X server -- VESA display driver
xserver-xorg-video-vga	1:4.1.0-8	X.Org X server -- VGA display driver
xserver-xorg-video-vmware	1:10.16.2-1	X.Org X server -- VMware display driver
xserver-xorg-video-voodoo	1:1.2.0-1	X.Org X server -- Voodoo display driver
xsltproc	1.1.24-2	XSLT command line processor
xulrunner-1.9	1.9.0.19-1	XUL + XPCOM application runner

yelp	2.22.1-8+b1	Help browser for GNOME 2
zenity	2.22.1-2	Display graphical dialog boxes from shell scripts
zlib1g	1:1.2.3.3.dfsg-12	compression library - runtime